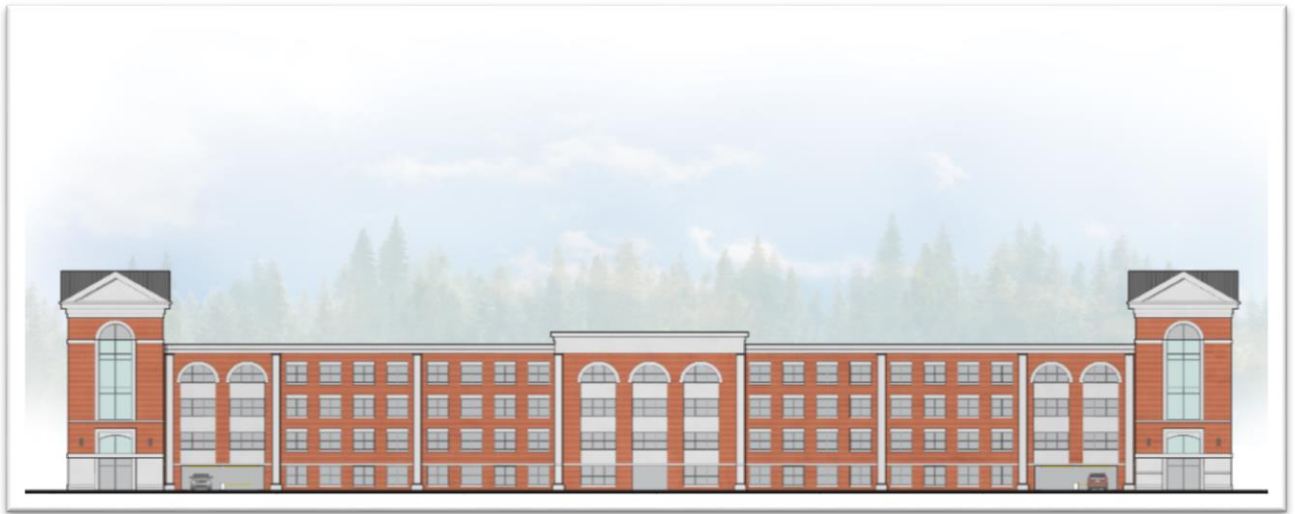




UNIVERSITY *of* NORTH CAROLINA at WILMINGTON
PARKING DECK II and SURFACE PARKING (DESIGN-BUILD)



CONSTRUCTION DOCUMENTS SUBMITTAL 01
(NOT FOR CONSTRUCTION)

4965 Riegel Road, Wilmington, NC

April 15, 2019

Clark Nexsen Commission No. 8112
SCO #: 18-19226-01A Code: 41828 Item: 301



The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

DOCUMENT 000010 – PROJECT TITLE PAGE

Parking Deck II

Owner:

University of North Carolina at Wilmington

Lisa Seifert, Project Manager
Facilities Management Building
601 S. College Road, Wilmington, NC 28403-5906
Phone: 919.962.2360

Contractor:

Balfour Beatty Construction, LLC

Tony Stoneking, Project Manager
406 South McDowell Street, Suite 200
Raleigh, NC 27601
Phone: 919.795.4954

Designer:

Clark Nexsen

Clark Nexsen Project No.: 8112
1523 Elizabeth Avenue, Suite 300
Charlotte, North Carolina 28204
Phone: 704.377.8800
Fax: 704.358.1037

Walker Consultants (Parking)
13860 Ballantyne Corporate Place, Suite 140
Charlotte, North Carolina 28204
Phone: 704.247.6230

McKim & Creed (Civil and Landscaping)
1730 Varsity Drive, Suite 500
Raleigh, North Carolina 27606
Phone: 919.233.5261

DOCUMENT 000107 - SEALS PAGE

1.1 CORPORATE

A. Clark Nexsen:



NC Corporate Engineering License #: C-1028

1.2 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Gary T. Runions
2. 7730



B. Civil Engineer

1. Richard Collier
2. 022574



C. Structural Engineer

1. Joey Roland
2. 028007



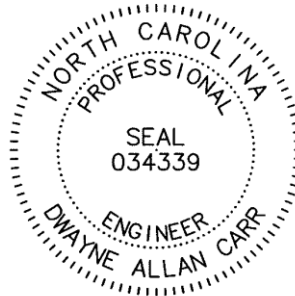
D. Plumbing:

1. Anthony (Tony) Brandon
2. 023940



E. Mechanical:

1. Dwayne Carr
2. 034339



F. Electrical Engineer:

1. Waleed Zoabi
2. 027786



G. Fire-Protection Engineer (Fire Alarm):

1. Kari E. Crane
2. 041524



H. Fire Protection Engineer:

1. Anthony (Tony) Brandon
2. 023940

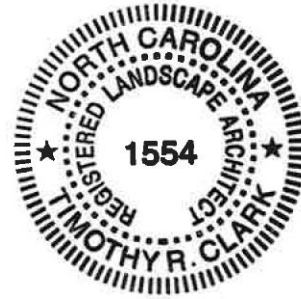


The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

I. Landscape Architect:

1. Tim Clark
2. PLA 1554



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GENERAL CONDITIONS OF THE CONTRACT

STANDARD FORM FOR DESIGN-BUILD AND DESIGN-BUILD-BRIDGING PROJECTS

NORTH CAROLINA

DEPARTMENT OF ADMINISTRATION

STATE CONSTRUCTION OFFICE

Form OC-15DB

This document is intended for use on State capital construction projects and shall not be used on any project that is not reviewed and approved by the State Construction Office. Extensive modification to the General Conditions by means of “Supplementary General Conditions” is strongly discouraged. State agencies and institutions may include special requirements in “Division 1 – General Requirements” of the specifications, where they do not conflict with the General Conditions.

First Edition – March 1, 2018

GENERAL CONDITIONS OF THE CONTRACT

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ARTICLE 1 - DEFINITIONS

- a. The **contract documents** consist of the General Conditions of the Contract; special conditions if applicable; bridging documents if applicable; Supplementary General Conditions; the drawing and specifications, including all bulletins, addenda or other modifications of the drawings and specifications incorporated into the documents prior to their execution; the contract; the performance bond; the payment bond; insurance certificates; the approval of the attorney general; and the certificate of the Office of State Budget and Management. All of these items together form the contract.
- b. The **Owner** (Governmental Entity) is the State of North Carolina or Owner's designated representative by and through the agency or institution named on the cover sheet, where the project is being built and shall include every officer, board, department, commission, or commissions charged with responsibility of preparation of specifications or entering into contracts for the erection, construction, alteration, or repair of any buildings for the State or for any county, municipality, or other public body.
- c. The **design professional** or **project designer** means any firm or firms of architects or engineers or both (and their consultants) professional licensed under Chapters 83A, 89A, or 89C of the General Statutes which have undertaken to design the project pursuant to a contract as part of the Design-Builder
- d. **Design-builder.** - An appropriately licensed person, corporation, or entity that, under a single contract, offers to provide or provides design services and/or general, mechanical, electrical, plumbing and/or sprinkler contracting services where services within the scope of the practice of professional engineering or architecture are performed respectively by a licensed engineer or licensed architect and where services within the scope of the practice of contracting are performed by a licensed general, mechanical, electrical, plumbing, and/or sprinkler contractor.
- e. **Bridging Architect** shall be the design professional contracted by the Governmental Entity separately from the Design Builder for the purpose of developing the bridging documents or Design Criteria services under a Design-Build Bridging contract
- f. **Design Criteria**, also referred to herein as Bridging Documents, shall be the requirements for a public project as expressed drawings and specifications to allow the Design-Builder to make a responsive bid proposal
- g. A **subcontractor** shall be in the case of a principal trade contractor, a general, mechanical, electrical or plumbing contractor or in the case of a specialty contractor, a trade contractor who is not a principal trade contractor, who has entered into a direct contract with the Design-Builder, and includes one who furnishes materials worked to a special or delegated design in accordance with plans and specifications covered by the contract documents.
- f. **Written notice** shall be defined as notice in writing delivered in person to the contractor, or to a partner of the firm in the case of a partnership, or to a member of the contracting organization, or to an officer of the organization in the case of a corporation, or sent to the last known business address of the contracting organization by registered mail.
- g. **Work**, as used herein as a noun, is intended to include materials, labor, and workmanship of the appropriate contractor or subcontractor as supervised or performed by or on behalf of the Design Builder.
- h. The **project** is the total design and construction work to be performed under the contract documents.

- i. **The Total Lump Sum Value of the Design Builder's work** is comprised of four parts:
- 1) **Design Services.** A lump sum amount for providing professional services as detailed in Article 15, inclusive of additional services for Construction Phase and Post Construction Phase services
 - 2) **Design Builders General conditions.** A lump sum amount for providing all project site and project related cost for management and administration the construction of the Work inclusive of preconstruction services.
 - 3) **Cost of Work.** A lump sum amount as used herein shall mean the cost for the labor, material, and equipment including subcontractor's cost of work required for the execution of the Project, but exclusive of the Design Builder's Fee for General Construction Services, Design Builder's Fee for Design Services, and Design Builder's cost for General Conditions.
 - 4) **Design Builder's Fee.** A fee for providing Design Services, General Conditions, and Cost of Work which includes all of the Design-Builder's home office costs including all of the Design-Builder's overhead costs and profit.
- j. **Change Order**, as used herein, shall mean a written order to the Design-Builder from owner subsequent to the signing of the contract authorizing a change in the design fees and/or contract amount relating to the costs of construction as defined in the contract. The change order shall be signed by the Design-Builder, and the Owner, and approved by the State Construction Office, in that order per Article 19 herein.
- k. **Field Order**, as used herein, shall mean a written approval for the Design-Builder to proceed with the work requested by Owner prior to issuance of a formal Change Order. The field order shall be signed by the Design-Builder, Owner, and State Construction Office (SCO).
- l. **Field Change**, as used herein shall mean a written approval from the Owner for the Design-Builder to proceed with work requested by the Owner to be paid for from the Design-Builder Contingency or Owner's Project Reserve within the GMP.
- m. **Liquidated damages**, is an amount reasonably estimated in advance to cover the consequential damages associated with the Owner's economic loss in not being able to use the Project for its intended purposes at the end of the contract's completion date as amended by change order, if any, by reason of failure of the CM to complete the work within the time specified. Liquidated damages does not include the Owner's extended contract administration costs (including but not limited to additional fees for architectural and engineering services, testing services, inspection services, commissioning services, penalties and violations with environmental laws and regulations, etc.), such other damages directly resulting from delays caused solely by the CM, or consequential damages that the Owner identified in the bid documents that may be impacted by any delay caused solely by the CM (e.g., if a multi-phased project-subsequent phases, delays in start of other projects that are dependent on the completion of this Project, extension of leases and/or maintenance agreements for other facilities).
- n. **Surety**, as used herein, shall mean the bonding company or corporate body which is bound with and for the Design-Builder, and which engages to be responsible for the Design-Builder and his acceptable performance of the work.
- o. **Routine written communications between the Design-Builder and the Owner** are any communication other than a "request for owner information" provided in letter, memo, or transmittal format, sent by mail, courier, electronic mail, or facsimile. Such communications cannot be identified as "request for owner information".

- p. **Clarification or Request for Owner Information (RFOI)** is a request from the Design-Builder seeking an interpretation or clarification by the Project Designer relative to the contract documents. The RFI, which shall be labeled (RFI), shall clearly and concisely set forth the issue or item requiring clarification or interpretation and why the response is needed. The RFI must set forth the Design-Builder's interpretation or understanding of the contract documents requirements in question, along with reasons for such an understanding.
- q. **Clarification or Request for information (RFI)** is a request from the Design-Builder seeking an interpretation or clarification by the Project Designer relative to the contract documents. The RFI, which shall be labeled (RFI), shall clearly and concisely set forth the issue or item requiring clarification or interpretation and why the response is needed. The RFI must set forth the Design-Builder's interpretation or understanding of the contract documents requirements in question, along with reasons for such an understanding.
- q. **Approval** means written or imprinted acknowledgement that materials, equipment or methods of construction are acceptable for use in the work.
- r. **Inspection** shall mean examination of work completed or in progress to determine its compliance with contract documents.
- s. **"Equal to" or "approved equal"** shall mean materials, products, equipment, assemblies, or installation methods considered equal by the bidder in all characteristics (physical, functional, and aesthetic) to those specified in the contract documents.
- t. **"Substitution" or "substitute"** shall mean materials, products, equipment, assemblies, or installation methods deviating in at least one characteristic (physical, functional, or aesthetic) from those specified, but which in the opinion of the bidder would improve competition and/or enhance the finished installation.

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS

- a. The drawings and specifications are complementary, one to the other. That which is shown on the drawings or called for in the specifications shall be as binding as if it were both called for and shown. The intent of the drawings and specifications is to establish the scope of all labor, materials, transportation, equipment, and any and all other things necessary to provide a complete job. In case of discrepancy or disagreement in the contract documents, the order of precedence shall be: Form of Contract, specifications, large-scale detail drawings, small-scale drawings.
- b. The wording of the specifications shall be interpreted in accordance with common usage of the language except that words having a commonly used technical or trade meaning shall be so interpreted in preference to other meanings.
- c. The Design Builder shall execute each copy of the response to RFQ/RFP, contract, performance bond and payment bond as follows:
 - 1. If the documents are executed by a sole Owner, that fact shall be evidenced by the word "Owner" appearing after the name of the person executing them.
 - 2. If the documents are executed by a partnership, that fact shall be evidenced by the word "Co-Partner" appearing after the name of the partner executing them.

3. If the documents are executed on the part of a corporation, they shall be executed by either the president or the vice president and attested by the secretary or assistant secretary in either case, and the title of the office of such persons shall appear after their signatures. The seal of the corporation shall be impressed on each signature page of the documents.
4. If the documents are made by a joint venture, they shall be executed by each member of the joint venture in the above form for sole Owner, partnership or corporation, whichever form is applicable to each particular member.
5. All signatures shall be properly witnessed.
6. If the Design-Builder's license is held by a person other than an Owner, partner or officer of a firm, then the licensee shall also sign and be a party to the contract. The title "Licensee" shall appear under his/her signature.
7. The bonds shall be executed by an attorney-in-fact. There shall be attached to each copy of the bond a certified copy of power of attorney properly executed and dated.
8. Each copy of the bonds shall be countersigned by an authorized individual agent of the bonding company licensed to do business in North Carolina. The title "Licensed Resident Agent" shall appear after the signature.
9. The seal of the bonding company shall be impressed on each signature page of the bonds.
10. The Design-Builder's signature on the performance bond and the payment bond shall correspond with that on the contract.

ARTICLE 3 - CLARIFICATIONS AND DETAIL DRAWINGS

- a. In such cases where the nature of the work requires clarification by the designer, such clarification shall be furnished by the designer by means of written instructions or detail drawings, or both. Clarifications and drawings shall be consistent with the intent of contract documents, and shall become a part thereof.
- b. The Design-Builder and the Designer shall prepare clarifications in accordance with progress of the work.
- c. The Designer shall submit and obtain approval from the Authority Having Jurisdiction (AHJ) any clarifications pertaining to Life Safety systems. Life safety items include but not limited to fire alarm, sprinkler, egress and exit lighting, fire rated walls, egress paths and security.

ARTICLE 4 - COPIES OF DRAWINGS AND SPECIFICATIONS

- a) In addition to any other requirements of the Owner, the Design-Builder shall furnish as many as required sets of clean black line prints plus an electronic copy of each set at each design milestone for reviewing agencies as well as a final set of Contract Documents to SCO and owner.

ARTICLE 5 - SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA

- a. Within thirty (30) consecutive calendar days of the notice to proceed, a schedule for anticipated submission of all shop drawings, product data, samples, and similar submittals shall be prepared by the Design-Builder and provided to the designer. This schedule shall indicate the items, relevant specification sections, other related submittal data, and the date when these items will be furnished to the designer.
- b. The Design-Builder will be responsible for logging, review, and approval of all shop drawings/submittals prior to submission to the Owner. The Design-Builder is to insure that shop drawings/submittal packages are submitted in an appropriate manner and, if not, return them to the Principal Trade or Specialty Contractor for proper submission.
- c. The Design-Builder shall develop and implement a system for the processing of all shop drawings/submittals and shall be responsible for tracking and monitoring all shop drawings/submittals until all have been approved by the Owner.

ARTICLE 6 - WORKING DRAWINGS AND SPECIFICATIONS AT THE JOB SITE

- a. The Design-Builder shall maintain, in readable condition at his job office, one complete set of working drawings and specifications for his work including all shop drawings. Such drawings and specifications shall be available for use by the Owner or his authorized representative.
- b. The Design-Builder may incorporate some shop drawings into the contract documents during the design of the project
- c. The Design-Builder shall maintain at the job office, a day-to-day record of work-in-place that is at variance with the contract documents. Such variations shall be fully noted on project drawings by the Design-Builder and submitted to the Owner upon project completion and no later than ninety (90) days after acceptance of the project.
- d. The Design-Builder shall maintain at the job office a record of all required tests that have been performed, clearly indicating the scope of work inspected and the date of approval or rejection.

ARTICLE 7 - OWNERSHIP OF DRAWINGS AND SPECIFICATIONS

All drawings and specifications are instruments of service and remain the property of the Owner. The use of these instruments on work other than this contract without permission of the Owner is prohibited. All copies of drawings and specifications other than contract copies shall be returned to the Owner upon request after completion of the work.

ARTICLE 8 - MATERIALS, EQUIPMENT, EMPLOYEES

- a. The Design-Builder shall, unless otherwise specified, supply & pay for all lighting, power, heat, sanitary facilities & water and shall require the Principal Trade and Specialty Contractors to, supply and pay for all labor, transportation, materials, tools, apparatus, scaffolding and incidentals necessary for the completion of his work, and to install, maintain and remove all equipment of the construction, other utensils or things, and be responsible for the safe, proper and lawful construction, maintenance and use of same. The Design-Builder shall construct in the best and most workmanlike manner, a complete job and everything incidental thereto, as shown on the plans, stated in the specifications, or reasonably implied there from, all in accordance with the contract documents.

- b. All materials shall be new and of quality specified, except where reclaimed material is authorized herein and approved for use. Workmanship shall at all times be of a grade accepted as the best practice of the particular trade involved, and as stipulated in written standards of recognized organizations or institutes of the respective trades except as exceeded or qualified by the specifications.
- c. Upon notice, the Design-Builder shall require the Principal Trade and Specialty Contractors to furnish evidence as to quality of materials.
- d. Products are generally specified by ASTM or other reference standard and/or by manufacturer's name and model number or trade name. When specified only by reference standard, the Design-Builder through the Principal Trade or Specialty Contractor may select any product meeting this standard, by any manufacturer. When several products or manufacturers are specified as being equally acceptable, the Design-Builder through the Principal Trade or Specialty Contractor has the option of using any product and manufacturer combination listed. However, the Design-Builder through the Principal Trade or Specialty Contractor shall be aware that the cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character and quality of product desired; and that equivalent products will be acceptable. The Design-Builder will be responsible for reviewing all substitution requests from Principal Trade or Specialty Contractors prior to submission to the Owner and shall track & monitor all such requests.
- e. The Design-Builder shall obtain written approval from the designer for the use of products, materials, equipment, assemblies or installation methods claimed as equal to those specified. Such approvals must be obtained as soon after contract awards as possible and before any materials are ordered.
- f. The Designer, in consultation and approval of the owner, is the judge of equality for proposed substitution of products, materials or equipment.
- g. If at any time during the construction and completion of the work covered by these contract documents, the conduct of any workman of the various crafts be adjudged a nuisance to the Owner or Design-Builder, or if any workman be considered detrimental to the work, the Design-Builder shall order such parties removed immediately from grounds.

ARTICLE 9 - ROYALTIES, LICENSES AND PATENTS

It is the intention of the contract documents that the work covered herein will not constitute in any way infringement of any patent whatsoever unless the fact of such patent is clearly evidenced herein. The Design-Builder shall protect and save harmless the Owner against suit on account of alleged or actual infringement. The Design-Builder shall pay all royalties and/or license fees required on account of patented articles or processes, whether the patent rights are evidenced hereinafter.

ARTICLE 10 - PERMITS, INSPECTIONS, FEES, REGULATIONS

- a. The Design-Builder shall give all notices and comply with all laws, ordinances, codes, rules and regulations bearing on the conduct of the work under this contract. Any necessary changes required after contract award shall be made by change order in accordance with Article 19. If the Design-Builder performs any work or authorizes any work to be performed knowing it to be contrary to such laws, ordinances, codes, rules and regulations, and without

such notice to the designer, he shall bear all cost arising there from. Additional requirements implemented after bidding will be subject to equitable negotiations.

- b. All work under this contract shall conform to the North Carolina State Building Code and other State, local and national codes as are applicable. The cost of all required inspections and permits shall be the responsibility of the Design-Builder unless otherwise specified.
- c. Projects constructed by the State of North Carolina or by any agency or institution of the State are not subject to inspection by any county or municipal authorities and are not subject to county or municipal building codes. The Design-Builder shall, however, cooperate with the county or municipal authorities by obtaining building permits. Permits shall be obtained at no cost.
- d. Projects involving local funding (Community Colleges) are also subject to county and municipal building codes and inspection by local authorities. The Design-Builder shall pay the cost of these permits and inspections unless otherwise specified.

ARTICLE 11 - PROTECTION OF WORK, PROPERTY AND THE PUBLIC

- a. The Design-Builder shall be responsible for the entire site and the building or construction of the same and provide all the necessary protections, as required by the Owner, and by laws or ordinances governing such conditions. The Design-Builder shall be responsible for any damage to the Owner's property or of that of others on the job, by them, their personnel, or their subcontractors, and shall make good such damages. The Design-Builder shall be responsible for and pay for any damages caused to the Owner. The Design-Builder shall have access to the project at all times.
- b. The Design-Builder shall provide cover and protect all portions of the structure when the work is not in progress, provide and set all temporary roofs, covers for doorways, sash and windows, and all other materials necessary to protect all the work on the building. Any work damaged through the lack of proper protection or from any other cause, shall be repaired or replaced without extra cost to the Owner.
- c. No fires of any kind will be allowed inside or around the operations during the course of construction without special permission from the Owner.
- d. The Design-Builder shall ensure that all trees and shrubs designated to remain in the vicinity of the construction operations are protected in accordance with the requirements of the plans and specifications. All walks, roads, etc., shall be barricaded to keep the public away from the construction. All trenches, excavations or other hazards in the vicinity of the work shall be well barricaded and properly lighted at night.
- e. The Design-Builder shall develop and implement a project safety plan that provides all necessary safety measures for the protection of all persons on the job, including the requirements of the A.G.C. *Accident Prevention Manual in Construction*, as amended, and shall fully comply with all state laws or regulations and North Carolina State Building Code requirements to prevent accident or injury to persons on or about the location of the work. The Design-Builder shall clearly mark or post signs warning of hazards existing, and shall barricade excavations, elevator shafts, stairwells and similar hazards. The Design-Builder shall insure that protection is provided against damage or injury resulting from falling materials and that all protective devices and signs be maintained throughout the progress of the work.
- f. The Design-Builder shall adhere to the rules, regulations and interpretations of the North Carolina Department of Labor relating to Occupational Safety and Health Standards for the

Construction Industry (Title 29, Code of Federal Regulations, Part 1926, published in Volume 39, Number 122, Part II, June 24, 1974, *Federal Register*), and revisions thereto as adopted by N.C.G.S. 95-126 through 155.

- g. The Design-Builder shall designate a responsible person of his organization as safety officer/inspector to inspect the project site for unsafe health and safety hazards, to report these hazards to the contractor for correction, and whose duties also include accident prevention on the project, and to provide other safety and health measures on the project site as required by the terms and conditions of the contract. The name of the safety inspector shall be made known to the designer and owner at the time of the preconstruction conference and in all cases prior to any work starting on the project.
- h. In the event of an emergency affecting the safety of life, the protection of work, or the safety of adjoining properties, the Design-Builder is hereby authorized to act at his own discretion, without further authorization from anyone, to prevent such threatened injury or damage. Any compensation claimed by the Design-Builder on account of such action shall be determined as provided for under Article 19(b).
- i. Any and all costs associated with correcting damage caused to adjacent properties of the construction site or staging area shall be borne by the contractor. These costs shall include but not be limited to flooding, mud, sand, stone, debris, and discharging of waste products.

ARTICLE 12 - SEDIMENTATION POLLUTION CONTROL ACT OF 1973

- a. Any land-disturbing activity performed by the Design-Builder or any Principal Trade or Specialty Contractor in connection with the project shall comply with all erosion control measures set forth in the contract documents and any additional measures which may be required in order to ensure that the project is in full compliance with the Sedimentation Pollution Control Act of 1973, as implemented by Title 15, North Carolina Administrative Code, Chapter 4, Sedimentation Control, Subchapters 4A, 4B and 4C, as amended (15 N.C.A.C. 4A, 4B and 4C).
- b. Upon receipt of notice that a land-disturbing activity is in violation of said act, the Design-Builder shall be responsible for ensuring that all steps or actions necessary to bring the project in compliance with said act are promptly taken.
- c. The Design-Builder shall be responsible for defending any legal actions instituted pursuant to N.C.G.S. 113A-64 against any party or persons described in this article.
- d. To the fullest extent permitted by law, the Design-Builder shall indemnify and hold harmless the Owner, the designer and the agents, consultants and employees of the Owner, from and against all claims, damages, civil penalties, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance of work or failure of performance of work, provided that any such claim, damage, civil penalty, loss or expense is attributable to a violation of the Sedimentation Pollution Control Act. Such obligation shall not be construed to negate, abridge or otherwise reduced any other right or obligation of indemnity which would otherwise exist as to any party or persons described in this article.

ARTICLE 13 - INSPECTION OF THE WORK

- a. It is a condition of this contract that the work shall be subject to inspection during normal working hours by the designated official representatives of the Owner, State Construction Office and those persons required by state law to test special work for official approval. The

Design-Builder shall therefore provide all equipment necessary and safe access to the work at all times for such inspections.

- b. All instructions to the Design-Builder will be made only by or through the designated project representative. Observations made by official representatives of the Owner shall be conveyed to the Design-Builder in writing.
- c. The Design-Builder shall perform quality control inspections on the work of Principal Trade and Specialty Contractors to guard the Owner against defects and deficiencies in the work. The Design-Builder shall advise the Project Designer and owner of any apparent variation and/or deviation from the intent of the Contract Documents and shall take the necessary action to correct such variations and deviations.
- d. Where special inspection or testing is required by virtue of any state laws, instructions of the designer, specifications or codes, the Design-Builder shall give adequate notice to the Project Designer and owner of the time set for such inspection or test, if the inspection or test will be conducted by a party other than the Project Designer. Such special tests or inspections will be made in the presence of the Designer and/or owner, or his authorized representative, and it shall be the Design-Builder's responsibility to serve ample notice of such tests.
- e. All laboratory tests shall be paid by the Design-Builder including but not limited to laboratory tests for hazardous materials and to establish design mix for concrete and for additional tests to prove compliance with contract documents where materials have tested deficient except when the testing laboratory did not follow the appropriate ASTM testing procedures.
- f. Should any work be covered up or concealed prior to inspection and approval by the Project Designer, owner and/or (SCO) such work shall be uncovered or exposed for inspection. Inspection of the work will be made promptly upon notice from the Design-Builder. All cost involved in uncovering, repairing, replacing, recovering and restoring to design condition, the work that has been covered or concealed will be paid by the Design-Builder.

ARTICLE 14 - CONSTRUCTION SUPERVISION AND SCHEDULE

- a. On-site representatives of the Design-Builder shall manage the work of the Principal Trade and Specialty Contractors and coordinate the work with the activities of the Owner to complete the project with the Owner's objectives of cost, time and quality. Throughout the progress of the work, the Design-Builder shall maintain a competent and adequate full-time staff approved by the Owner. It is understood that the designated and approved on-site representatives of the Design-Builder will remain on the job and in responsible charge as long as those persons remain employed by the Design-Builder unless otherwise requested or agreed to by the Owner. The Design-Builder shall establish an on-site organization with appropriate lines of authority to act on behalf of the Design-Builder. Instructions, directions or notices given to the designated on-site authority shall be as binding as if given to the Design-Builder. However, directions, instructions, and notices shall be confirmed in writing.
- b. {NOT USED}
- c. {NOT USED}
- d. The Design-Builder shall call and preside over monthly job site progress conferences. All Principal Trade and Specialty Contractors, as well as Designer and all subconsultants, shall be represented at these job progress conferences by both home office and project personnel. The Design-Builder shall require attendance from other subcontractors and material suppliers who can contribute toward maintaining required job progress. It shall be the principal purpose

of these meetings, or conferences, to effect coordination, cooperation and assistance in every practical way toward the end of maintaining progress of the project on schedule and to complete the project within the specified contract time. The Design-Builder shall be prepared to assess progress of the work and to recommend remedial measures for correction of progress as may be appropriate.

- e. The Design-Builder shall, if required by the Supplementary General Conditions, employ an engineer or a land surveyor licensed in the State of North Carolina to lay out the work and to establish a bench mark nearby in a location where same will not be disturbed and where direct instruments sights may be taken.
- f. {NOT USED}
- g. Prior to bidding, it shall be the responsibility of the Design-Builder to prepare an electronic and paper copy of a preliminary critical path method (CPM) schedule and submit such schedule to the owner for his review and comment in sufficient time to allow revisions prior to inserting said schedule into the Principal Trade and Specialty Contractors' bid packages. After contract award but prior to thirty (30) days from the date of the notice to proceed, the Design-Builder shall obtain from the Principal Trade and Specialty Contractors their respective work activities and integrate them into a project construction schedule in CPM form. The resulting CPM schedule shall show all salient features of the work required for construction of the project from start to finish within the time allotted by the contract. The time in days between the Design-Builder's early completion date and the contractual completion date is project float time and shall be used as such by the Design-Builder unless amended by change order. The Design-Builder shall submit to the owner an electronic and paper copy of the final CPM schedule after contracts are executed but within fifteen (15) days prior to the written notice to proceed. The owner after reviewing and commenting on the project CPM schedule shall submit it to the Design-Builder for incorporation of comments. No application for payment will be processed until the project CPM schedule is approved by the Owner. No monthly application for payment will be processed without the submission of an electronic and paper copy of the CPM schedule attached.
- h. The CPM schedule shall be a complete computer generated network analysis showing the complete sequence of construction activities, identifying the work of separate stages and other logically grouped activities, indicating early and late start and early and late finish dates, float duration and a complete logic. Monthly updates will show the estimated completion of each activity.
- i. The Design-Builder shall distribute to the principal trade and specialty contractors the approved project CPM schedule and shall display same at the job site.
- j. The Design-Builder shall maintain the project CPM schedule, making monthly adjustments, updates, corrections, etc., which are necessary to finish the project within the time allotted by the contract. In doing so, the Design-Builder shall keep the designer as well as all Principal Trade and Specialty Contractors fully informed as to all changes and updates to the schedule. The Design-Builder shall submit to the owner a monthly report of the status of all work activities. The monthly status report shall show the actual work completed to date in comparison with the original amount of work scheduled. If the work is behind schedule, the Design-Builder must indicate in writing what measures are being taken to bring the work back on schedule and ensure that the contract completion date is not exceeded. If the work is greater than thirty (30) days behind schedule and no legitimate requests for time extensions are in process, then the Design-Builder shall prepare and submit to the owner a recovery schedule for review and approval. Failure of the Design-Builder to abide by the directives in

this paragraph will give the Owner cause to exercise the remedies set forth in Article 29 of the General Conditions and pursue any other legal remedies allowed it by law.

ARTICLE 15 – {NOT USED}

ARTICLE 16 - PRINCIPAL TRADE AND SPECIALTY CONTRACTS AND CONTRACTORS

- a. Where the Design-Builder has provided a list of licensed contractor and/or subcontractors in the Design-Builder's formal response to the Request for Proposal whom the design-builder proposes to use for the project's design and construction, the Design-Builder shall award contracts to those licensed contractors and/or subcontractors based on their fixed price proposal and taking into consideration the quality, performance, time specified in the proposal, compliance with N.C.G.S. 143-128.2 and other factors deemed appropriate by the Owner. Any Principal Trade and Specialty Contracts that are not listed in the Design-Builder's formal response to the Request for Proposal, or that will not be self-performed, shall be publicly advertised and shall be opened publically in a public venue, and once opened, shall be public records under N.C.G.S. 132. The Design-Builder shall award the contract to the lowest responsible, responsive bidder, taking into consideration quality, performance, the time specified in the bids for performance of the contract, the time for completion, compliance with N.C.G.S. 143-128.2, and other factors deemed appropriate by the Owner and advertised as part of the bid solicitation. When contracts are awarded pursuant to this section, the Owner shall provide for a dispute resolution procedure as provided by N.C.G.S. 143-128(f1). Once Principal Trade and Specialty Contractors are in place, the Design-Builder shall provide copies of the contracts to the owner and also provide a list of equipment and material suppliers.
- b. The Design-Builder will furnish to any Principal Trade or Specialty Contractor, upon request, evidence regarding amounts of money paid to the Design-Builder on account of the work of the Principal Trade or Specialty Contractor.
- c. The Design-Builder is and remains fully responsible for his own acts or omissions as well as those of any Principal Trade or Specialty Contractor or of any employee of either. The Design-Builder agrees that no contractual relationship exists between the Principal Trade and Specialty Contractors and the Owner in regard to the contract, and that the Principal Trade and Specialty Contractors act on this work as an agent or employee of the Design-Builder.

ARTICLE 17 – DESIGN-BUILDER AND SUBCONTRACTOR RELATIONSHIPS

The Design-Builder agrees that the terms of these contract documents shall apply equally to each Principal Trade and Specialty Contractor as to the Design-Builder, and the Design-Builder agrees to take such action as may be necessary to bind each Principal Trade and Specialty Contractor to these terms. The Design-Builder further agrees to conform to the Code of Ethical Conduct as adopted by the Associated General Contractors of America, Inc., with respect to Design-Builder-subcontractor relationships, and that payments to Principal Trade and Specialty Contractors shall be made in accordance with the provisions of N.C.G.S. 143-134.1 titled Interest on final payments due to prime contractors: payments to subcontractors.

- a. On all public construction contracts which are let by a board or governing body of the state government or any political subdivision thereof, except contracts let by the Department of Transportation pursuant to N.C.G.S. 136-28.1, the balance due the Design-Builder shall be paid in full within 45 days after respective prime contracts of the project have been accepted by the Owner, certified by the architect, engineer or designer to be completed in accordance with terms of the plans and specifications, or occupied by the Owner and used for the purpose for which the project was constructed, whichever occurs first. Provided, however, that

whenever the architect or consulting engineer in charge of the project determines that delay in completion of the project in accordance with terms of the plans and specifications is the fault of the Design-Builder, the project may be occupied and used for the purposes for which it was constructed without payment of any interest on amounts withheld past the 45 day limit. Should final payment to the Design-Builder beyond the date such contracts have been certified to be completed by the Project Design-Builder, accepted by the Owner, or occupied by the Owner and used for the purposes for which the project was constructed, be delayed by more than 45 days, said Design-Builder shall be paid interest, beginning on the 46th day, at the rate of one percent (1%) per month or fraction thereof unless a lower rate is agreed upon on such unpaid balance as may be due. In addition to the above final payment provisions, periodic payments due the Design-Builder during construction shall be paid in accordance with the payment provisions of the contract documents or said Design-Builder shall be paid interest on any such unpaid amount at the rate stipulated above for delayed final payments. Such interest shall begin on the date the payment is due and continue until the date on which payment is made. Such due date may be established by the terms of the contract. Funds for payment of such interest on state-owned projects shall be obtained from the current budget of the owning department, institution or agency. Where a conditional acceptance of a contract exists, and where the Owner is retaining a reasonable sum pending correction of such conditions, interest on such reasonable sum shall not apply.

- b. Within seven days of receipt by the Design-Builder of each periodic or final payment, the Design-Builder shall pay the Principal Trade and Specialty Contractors based on work completed or service provided under their contract with the Design-Builder. Should any periodic or final payment to a Principal Trade or Specialty Contractor be delayed by more than seven days after receipt of periodic or final payment by the Design-Builder, the Design-Builder shall pay the Principal Trade or Specialty Contractor interest, beginning on the eighth day, at the rate of one percent (1%) per month or fraction thereof on such unpaid balance as may be due.
- c. The percentage of retainage on payments made by the Design-Builder to the Principal Trade and Specialty Contractors shall not exceed the percentage of retainage on payments made by the Owner to the Design-Builder. Any percentage of retainage on payments made by the Design-Builder to the Principal Trade or Specialty Contractors that exceeds the percentage of retainage on payments made by the Owner to the Design-Builder shall be subject to interest to be paid by the Design-Builder to the Principal Trade or Specialty Contractor at the rate of one percent (1%) per month or fraction thereof.
- d. Nothing in this section shall prevent the Design-Builder at the time of application and certification to the Owner from withholding application and certification to the Owner for payment to a Principal Trade or Specialty Contractor for unsatisfactory job progress; defective construction not remedied; disputed work; third-party claims filed or reasonable evidence that claim will be filed; failure of the Principal Trade or Specialty Contractor to make timely payments for labor, equipment and materials; damage to Design-Builder or another subcontractor; reasonable evidence that a Principal Trade or Specialty Contract cannot be completed for the unpaid balance of the subcontract sum; or a reasonable amount for retainage not to exceed the initial percentage retained by Owner.

ARTICLE 18 - DESIGNER'S STATUS

- a. The Design-Builder shall contract with a licensed design professional to perform professional engineering or architectural services and this licensed design professional shall serve as the Project Designer. The Project Designer shall provide necessary inspection of the work to ensure compliance with plans and specifications. He has authority to notify the Design-

Builder and the Owner of work that needs to be removed, corrections to faulty work or other such actions that may be necessary to assure successful completion of the work.

- b. The Project Designer even while contracted for services with the Design builder shall maintain a position of an impartial interpreter of the contract documents, and, as such, he shall exercise his powers under the contract to enforce faithful performance by both the Owner and the Design-Builder, taking sides with neither.
- c. Should the Project Designer cease to be employed on the work for any reason whatsoever, then the Design-Builder shall employ a competent replacement, approved by the owner, who shall assume the status of the former Project Designer.
- d. The Project Designer will make periodic inspections of the project at intervals appropriate to the stage of construction. He will inspect the progress, the quality and the quantity of the work.
- e. The Project Designer and the Owner shall have access to the work whenever it is in preparation and progress during normal working hours. The Design-Builder shall provide facilities for such access so the Designer and Owner may perform his functions under the contract documents.
- f. Based on the Project Designer's inspections and evaluations of the project, the Project Designer shall issue interpretations, directives and decisions as may be necessary to assist the Owner in the administration of the project. The Owner's decisions relating to artistic effect and technical matters shall be final, provided such decisions are within the limitations of the contract. The Design-Builder's decisions, however, relating to means and methods, and administration of the contracts the Design-Builder holds are final.

ARTICLE 19 - CHANGES IN THE WORK

- a. The Owner may have changes made in the work covered by the contract. These changes will not invalidate and will not relieve or release the Design-Builder from any guarantee given by him pertinent to the contract provisions. These changes will not affect the validity of the guarantee bond and will not relieve the surety or sureties of said bond. All extra work shall be executed under conditions of the original contract.
- b. Except in an emergency endangering life or property, no change in the GMP contract shall be made by the Design-builder except upon receipt of approved change order or written field order from the Design Builder, countersigned by the owner and the State Construction Office authorizing such change. No claim for adjustments of the contract price shall be valid unless this procedure is followed.

A Field Order, transmitted by fax, digitally, or hand delivered may be used where the change involved impacts the critical path of the work. A formal Change Order shall be issued within the time stated on the field order.

The Design-Builder may be requested to make a change to the work by the Owner where such work is to be funded by the Design-Builder Contingency or Project Reserve that is part of the GMP contract. Such a change must be documented in the same manner as a Change Order and must be authorized in writing by the Owner by a Field Change document.

In the event of emergency endangering life or property, the Design-Builder may be directed to proceed on a time and material basis whereupon the Design-Builder shall proceed and keep accurately on such form as may be required, a correct account of costs together with all proper

invoices, payrolls and supporting data. Upon completion of the work the change order will be prepared as outlined under either Method "c(1)" or Method "c(2)" or both.

- c. In determining the values of changes, either additive or deductive, the Design-Builder and Principal Trade and Specialty Contractors are restricted to the use of the following methods:
 - 1. Where the extra work involved is covered by unit prices quoted in the proposal, the value of the change shall be computed by application of unit prices based on quantities, estimated or actual as agreed of the items involved, except in such cases where a quantity exceeds the estimated quantity allowance in the contract by one hundred percent (100%) or more. In such cases, either party may elect to proceed under subparagraph c2 herein. If neither party elects to proceed under c2, then unit prices shall apply.
 - 2. Otherwise, the contracting parties shall negotiate and agree upon the equitable value of the change prior to issuance of the change order, and the change order shall stipulate the corresponding lump sum adjustment to the contract price.
- d. Under Paragraph "b" and Methods "c(2)" above, the allowances for overhead and profit combined the allowances for overhead and profit combined shall be as follows: all contractors (the single contracting entity (Design Builder), his subcontractors (1st tier subs), or their sub-subcontractors (2nd tier subs, 3rd tier subs, etc)) shall be allowed a maximum of 10% on work they each self-perform; the Design Builder shall be allowed a maximum of 5% on contracted work of his 1st tier sub; 1st tier, 2nd tier, 3rd tier, etc contractors shall be allowed a maximum of 2.5% on the contracted work of their subs. No additional allowances for overhead and profit shall be allowed. In the case of deductible change orders, under Method "c(2)" and Paragraph (b) above, the contractor shall include no less than five percent (5%) profit, but no allowances for overhead.
- e. The term "net cost" as used herein shall mean the difference between all proper cost additions and deductions. The "cost" as used herein shall be limited to the following:
 - 1. The actual costs of materials and supplies incorporated or consumed as part of the project;
 - 2. The actual costs of labor expended on the project site;
 - 3. The actual costs of labor burden, limited to the costs of social security (FICA) and Medicare/Medicaid taxes; unemployment insurance costs; health/dental/vision insurance premiums; paid employee leave for holidays, vacation, sick leave, and/or petty leave, not to exceed a total of 30 days per year; retirement contributions; worker's compensation insurance premiums; and the costs of general liability insurance when premiums are computed based on payroll amounts; the total of which shall not exceed thirty percent(30%) of the actual costs of labor;
 - 4. The actual costs of rental for tools, excluding hand tools; equipment; machinery; and temporary facilities required for the project;
 - 5. The actual costs of premiums for bonds, insurance, permit fees and sales or use taxes related to the project.

Overtime and extra pay for holidays and weekends may be a cost item only to the extent approved by the Owner.

- f. Should concealed conditions be encountered in the performance of the work below grade, or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the contract documents, the contract sum and time for completion may be equitably adjusted by change order upon claim by either party made within thirty (30) days

after the condition has been identified. The cost of such change shall be arrived at by one of the foregoing methods.

All change orders shall be supported by a breakdown showing method of arriving at net cost as defined above.

- g. In all change orders, the procedure will be for the Design-Builder or the Owner to request proposals for the change order work in writing. The Design-Builder will require the Principal Trade and Specialty Contractors to provide such proposals and supporting data in suitable format and will review and approve such change orders prior to submission to the Owner. The Designer shall verify correctness and make a recommendation to the Owner. If the Owner agrees with the Designer's recommendation, they shall execute the change order and forward to the State Construction Office for final approval, within fourteen (14) days of receipt or forward a response to the Design Builder within the same time period. The State Construction Office shall act on the change order within seven (7) days. Upon approval by the State Construction Office, the State Construction Office shall distribute to the Owner for distribution to the Design-Builder and the surety. In case of emergency or extenuating circumstances, approval of changes may be obtained verbally by telephone or field orders approved by all parties, then shall be substantiated in writing as outlined under normal procedure.
- h. At the time of signing a change order, the Design-Builder shall be required to certify as follows:

"I certify that my bonding company will be notified forthwith that my contract has been changed by the amount of this change order, and that a copy of the approved change order will be mailed upon receipt by me to my surety."
- i. A change order, when issued, shall be full compensation, or credit, for the work included, omitted or substituted. It shall show on its face the adjustment in time for completion of the project as a result of the change in the work.
- j. If, during the progress of the work, the Owner requests a change order and the Design-Builder's terms are unacceptable, the Owner, with the approval of the State Construction Office, may require the Design-Builder to perform such work on a time and material basis in accordance with paragraph "b" above. Without prejudice, nothing in this paragraph shall preclude the Owner from performing or to have performed that portion of the work requested in the change order.

ARTICLE 20 - CLAIMS FOR EXTRA COST

- a. Should the Design-Builder consider that as a result of any instructions given in any form by the Owner, he is entitled to extra cost above that stated in the contract, he shall give written notice thereof to the Owner within seven (7) days without delay. The written notice shall clearly state that a claim for extra cost is being made and shall provide a detailed justification for the extra cost. The Design-Builder shall not proceed with the work affected until further advised, except in emergency involving the safety of life or property, which condition is covered in Article 19(b) and Article 11(h). No claims for extra compensation will be considered unless the claim is so made. The Owner shall render a written decision within fourteen (14) days of receipt of claim.
- b. The Design-Builder shall not act on instructions received by him from persons other than the Owner, and any claims for extra compensation or extension of time on account of such instruction will not be honored. The Owner will not be responsible for misunderstandings

claimed by the Design-Builder of verbal instructions which have not been confirmed in writing, and in no case shall instructions be interpreted as permitting a departure from the contract documents unless such instruction is confirmed in writing and supported by a properly authorized change order.

- c. Should a claim for extra compensation by the Design-Builder be denied by the Owner, and cannot be resolved by a representative of the State Construction Office, the Design-Builder may request a mediation in connection with N.C.G.S. 143-128(f1) in the dispute resolution rules adopted by the State Building Commission. If the Design-Builder is unable to resolve its claims as a result of mediation, then the Design-Builder may pursue his claim in accordance with the provisions of N.C.G.S. 143-135.3 and the following:
 1. A Design-Builder who has not completed a contract with a state agency or institution for construction or repair work and who has not received the amount he claims is due under the contract may submit a verified written claim to the Director of the State Construction Office of the Department of Administration for the amount the Design-Builder claims is due. The Director may deny, allow or compromise the claim, in whole or in part. A claim under this subsection is not a contested case under N.C.G.S. Chapter 150B.
 2.
 - (a) A Design-Builder who has completed a contract with a State agency or institution for construction or repair work and who has not received the amount he claims is due under the contract may submit a verified written claim to the Director of the State Construction Office of the Department of Administration for the amount the Design-Builder claims is due. The claim shall be submitted within sixty (60) days after the Design-Builder receives a final statement of the board's disposition of his claim and shall state the factual basis for the claim.
 - (b) The Director shall investigate a submitted claim within ninety (90) days of receiving the claim, or within any longer time period upon which the Director and the Design-Builder agree. The Design-Builder may appear before the Director, either in person or through counsel, to present facts and arguments in support of his claim. The Director may allow, deny or compromise the claim, in whole or in part. The Director shall give the Design-Builder a written statement of the Director's decision on the Design-Builder's claim.
 - (c) A Design-Builder who is dissatisfied with the Director's decision on a claim submitted under this subsection may commence a contested case on the claim under Chapter 150B of the General Statutes. The contested case shall be commenced within sixty (60) days of receiving the Director's written statement of the decision.
 - (d) As to any portion of a claim that is denied by the Director, the Design-Builder may, in lieu of the procedures set forth in the preceding subsection of this section, within six (6) months of receipt of the Director's final decision, institute a civil action for the sum he claims to be entitled to under the contract by filing a verified complaint and the issuance of a summons in the Superior Court of Wake County or in the superior court of any county where the work under the contract was performed. The procedure shall be the same as in all civil actions except that all issues shall be tried by the judge, without a jury.

ARTICLE 21 - MINOR CHANGES IN THE WORK

The Owner will have the authority to order minor changes in the work not involving an adjustment in the contract sum or time for completion, and not inconsistent with the intent of the contract

documents. Such changes shall be effected by written order, copied to the State Construction Office, and shall be binding on the Owner and the Design-Builder.

ARTICLE 22 - UNCORRECTED FAULTY WORK

Should the correction of faulty or damaged work be considered inadvisable or inexpedient by the Owner, the Owner shall be reimbursed by the Design-Builder. A change order will be issued to reflect a reduction in the contract sum.

ARTICLE 23 - TIME OF COMPLETION, DELAYS, EXTENSION OF TIME

- a. The final completion date will be as determined by the Owner and Design-Builder during the pre-construction phase of the project and will be incorporated into the contract for construction services between the Owner and the Design-Builder.
- b. The Design-Builder shall commence work to be performed under this agreement on a date to be specified in a written Notice to Proceed from the Owner and shall fully complete all work hereunder within the time of completion specified. For each day in excess of the above number of days, the Design-Builder shall pay the Owner the sum stated as liquidated damages reasonably estimated in advance to cover the losses to be incurred by the Owner by reason of failure of the Design-Builder to complete the work within the time specified, such time being in the essence of this contract and a material consideration thereof.
- c. {NOT USED}
- d. If the Design-Builder is delayed at any time in the progress of his work by any act or negligence of the Owner; by changes ordered in the work; by labor disputes at the project site; by abnormal weather conditions not reasonably anticipated for the locality where the work is performed; by unavoidable casualties; by any causes beyond the contractor's control; or by any other causes which the Owner determine may justify the delay, then the contract time may be extended by change order for the time which Owner may determine is reasonable and is supported by schedule analysis from the Design-Builder demonstrating delays/impacts to completing critical path activities in the schedule submitted under Article 14 (including but not limited to delayed starts, finishes and/or extended durations, etc.).

Time extensions will not be granted for rain, wind, snow or other natural phenomena of **normal intensity** for the locality where work is performed. For purpose of determining extent of delay attributable to unusual weather phenomena, a determination shall be made by comparing the weather for the contract period involved with the average of the preceding five (5) year climatic range during the same time interval based on the National Oceanic and Atmospheric Administration National Weather Service statistics for the locality where work is performed and on daily weather logs kept on the job site by the Design-Builder reflecting the effect of the weather on progress of the work and initialed by the designer's representative. Time extensions for weather delays do not entitle the Design-Builder to "extended overhead" recovery. No weather delays will be considered after the building is dried in unless work claimed to be delayed is on the critical path of the approved baseline schedule or approved updated schedule. Time extensions for acts of God, labor disputes, fire, delays in transportation, unavoidable casualties or other delays which are beyond the control of the Owner do not entitle the Design-Builder compensable damages for delays. Any claim for compensable damages for delays is limited to delays solely by the Owner. In the case of concurrent delays, Design-Builder caused delays shall be accounted for before Owner caused delays.

- e. Request for extension of time shall be made in writing within twenty (20) days following cause of delay and shall include supporting schedule analysis referenced in paragraph (d) above and/or as required in supplemental general conditions and/or specifications. In case of continuing cause for delay, the Design-Builder shall notify the Owner of the delay within twenty (20) days of the beginning of the delay and only one claim is necessary.
- f. The Design-Builder shall notify his surety in writing of extension of time granted.

ARTICLE 24 - PARTIAL UTILIZATION/BENEFICIAL OCCUPANCY

- a. The Owner may desire to occupy or utilize all or a portion of the project when the work is substantially complete.
- b. Prior to the final payment, the Owner, with the approval of the State Construction Office, may request the Design-Builder in writing, to permit him to use a specified part of the project which he believes he may use without significant interference with construction of the other parts of the project. If the Design-Builder agrees, the Owner will schedule a beneficial occupancy inspection, with the approval of the State Construction Office, after which the Design Builder will prepare a certificate of substantial completion. The certificate shall include the following documentation:
 - 1. Date of beneficial occupancy.
 - 2. A tentative list of items to be completed or corrected before final payment.
 - 3. Establishing responsibility between the Design-Builder and Owner for maintenance, heat, utilities and insurance.
 - 4. Establishing the date for guarantees and warranties under terms of the contract.
 - 5. Consent of surety.
 - 6. Endorsement from insurance company permitting occupancy.
- c. The Owner shall have the right to exclude the Design-Builder from any part of the project which the Project Designer has so certified to be substantially complete, but the Owner will allow the Design-Builder reasonable access to complete or correct work to bring it into compliance with the contract.
- d. Occupancy by the Owner under this article will in no way relieve the Design-Builder from his contractual requirement to complete the project within the specified time.

ARTICLE 25 - FINAL INSPECTION, ACCEPTANCE, AND PROJECT CLOSEOUT

- a. Upon notification from the Design-Builder that the project is complete and ready for inspection, the Project Designer shall make a preliminary final inspection to verify that the project is complete and ready for final inspection. Prior to final inspection, the Design-Builder shall ensure that all items requiring corrective measures noted at the preliminary inspection are complete. The Project Designer shall schedule a final inspection at a time and date acceptable to the Owner, the Design-Builder and the State Construction Office.
- b. {NOT USED}

- c. At the final inspection, the Project Designer shall, if job conditions warrant, record a list of items that are found to be incomplete or not in accordance with the contract documents. At the conclusion of the final inspection, the Project Designer and State Construction Office representative shall make the following determinations:
 - 1. That the project is completed and accepted.
 - 2. That the project is accepted subject to the list of discrepancies (punch list). All punch list items must be completed within thirty (30) days of acceptance or the Owner may invoke Article 28, Owner's Right to Do Work.
 - 3. That the project is not complete and another date for a final inspection will be established.
- d. Within fourteen (14) days of acceptance per Paragraph c1 or within fourteen (14) days after completion of punch list per Paragraph c2 above, the Project Designer shall certify the work and issue applicable certificate(s) of compliance.
- e. Any discrepancies listed or discovered after the date of final inspection and acceptance under Paragraphs c1 or c2 above shall be handled in accordance with Article 42.
- f. The date of acceptance will establish the following:
 - 1. The beginning of guarantees and warranties period.
 - 2. The date on which the Design-Builder's insurance coverage for public liability, property damage and builder's risk may be terminated.
 - 3. That no liquidated damages (if applicable) shall be assessed after this date.
 - 4. The termination date of utility cost to the Design-Builder (if applicable).

ARTICLE 26 - CORRECTION OF WORK BEFORE FINAL PAYMENT

- a. Any work, materials, fabricated items or other parts of the work which have been condemned or declared not in accordance with the contract by the Project Designer and/or owner shall be promptly removed from the work site by the Design-Builder, and shall be immediately replaced by new work in accordance with the contract at no additional cost to the Owner. Work or property of the Owner, damaged or destroyed by virtue of such faulty work, shall be made good at the expense of the Design-Builder.
- b. Correction of condemned work described above shall commence within twenty-four (24) hours after receipt of notice from the Project Designer, and shall make satisfactory progress until completed.
- c. Should the Design-Builder fail to proceed with the required corrections, then the Owner may complete the work in accordance with the provisions of Article 28.

ARTICLE 27 - CORRECTION OF WORK AFTER FINAL PAYMENT

See Article 35, Performance Bond and Payment Bond, and Article 42, Guarantee. Neither the final certificate, final payment, occupancy of the premises by the Owner, nor any provision of the contract, nor any other act or instrument of the Owner, shall relieve the Design-Builder from responsibility for negligence, or faulty material or workmanship, or failure to comply with the

drawings and specifications. The Design-Builder shall correct or make good any defects due thereto and repair any damage resulting therefrom, which may appear during the guarantee period following final acceptance of the work except as stated otherwise under Article 42, Guarantee. The Owner will report any defects as they may appear to the Design-Builder and establish a time limit for completion of corrections by the Design-Builder. The Owner will be the judge as to the responsibility for correction of defects.

ARTICLE 28 - OWNER'S RIGHT TO DO WORK

If, during the progress of the work or during the period of guarantee, the Design-Builder fails to prosecute the work properly or to perform any provision of the contract, the Owner, after seven (7) days written notice sent by certified mail, return receipt requested, to the Design-Builder from the Owner, may perform or have performed that portion of the work. The cost of the work may be deducted from any amounts due or to become due to the Design-Builder, such action and cost of same having been first approved by the Owner. Should the cost of such action of the Owner exceed the amount due or to become due the Design-Builder, then the Design-Builder or his surety, or both, shall be liable for and shall pay to the Owner the amount of said excess.

ARTICLE 29 - ANNULMENT OF CONTRACT

If the Design-Builder fails to begin the work under the contract within the time specified or fails to establish a GMP or obtain bids from or enter into contracts with qualified Principal Trade or Specialty Contractors within the GMP, or the progress of the work is not maintained on schedule, or the work is not completed within the time above specified, or fails to perform the work with sufficient workmen and equipment or with sufficient materials to ensure the prompt completion of said work, or shall perform the work unsuitably or shall discontinue the prosecution of the work, or if the Design-Builder shall become insolvent or be declared bankrupt or commit any act of bankruptcy or insolvency, or allow any final judgment to stand against him unsatisfied for a period of forty-eight (48) hours, or shall make an assignment for the benefit of creditors, or for any other cause whatsoever shall not carry on the work in an acceptable manner, the Owner may give notice in writing, sent by certified mail, return receipt requested, to the Design-Builder and his surety of such delay, neglect or default, specifying the same, and if the Design-Builder within a period of seven (7) days after such notice shall not proceed in accordance therewith, then the Owner shall, declare this contract in default, and, thereupon, the surety shall promptly take over the work and complete the performance of this contract in the manner and within the time frame specified. In the event the surety shall fail to take over the work to be done under this contract within seven (7) days after being so notified and notify the Owner in writing, sent by certified mail, return receipt requested, that he is taking the same over and stating that he will diligently pursue and complete the same, the Owner shall have full power and authority, without violating the contract, to take the prosecution of the work out of the hands of said Design-Builder, to appropriate or use any or all contract materials and equipment on the grounds as may be suitable and acceptable and may enter into an agreement, either by public letting or negotiation, for the completion of said contract according to the terms and provisions thereof or use such other methods as in his opinion shall be required for the completion of said contract in an acceptable manner. All costs and charges incurred by the Owner, together with the costs of completing the work under contract, shall be deducted from any monies due or which may become due said Design-Builder and surety. In case the expense so incurred by the Owner shall be less than the sum which would have been payable under the contract, if it had been completed by said Design-Builder, then the said Design-Builder and surety shall be entitled to receive the difference, but in case such expense shall exceed the sum which would have been payable under the contract, then the Design-Builder and the surety shall be liable and shall pay to the Owner the amount of said excess.

ARTICLE 30 – DESIGN-BUILDER’S RIGHT TO STOP WORK OR TERMINATE THE CONTRACT

- a. Should the work be stopped by order of a court having jurisdiction, or by order of any other public authority for a period of three months, due to cause beyond the fault or control of the Design-Builder, or if the Owner should fail or refuse to make payment on account of a certificate issued within thirty (30) days after receipt of same, then the Design-Builder, after fifteen (15) days' written notice sent by certified mail, return receipt requested, to the Owner, may suspend operations on the work or terminate the contract.
- b. The Owner shall be liable to the Design-Builder for the cost of all materials delivered and work performed on this contract plus 10 percent overhead and profit and shall make such payment.

ARTICLE 31 - REQUEST FOR PAYMENT

- a. Based on applications for payment submitted to the Project Designer by the Design-Builder and certificates for payment issued by the Project Designer, the Owner shall make progress payments on account of the contract sum to the Design-Builder as provided below and elsewhere in the contract documents. The period covered by each application for payment shall be one calendar month ending on the last day of the month.
- b. Provided an application for payment is received by the Project Designer not later than the 5th day of the month, the Owner shall make payment to the Design-Builder not later than the 20th day of the following month. If an application for payment is received by the Project Designer after the application date fixed above, payment shall be made by the Owner not later than forty-five days after the Project Designer receives the application for payment.
- c. Prior to submitting the first payment request, the Design-Builder shall prepare a schedule showing a breakdown of the contract price into values of the various parts of the GMP contract. The Cost of the Work breakdown will be arranged so as to facilitate payments to the Principal Trade and Specialty Contractors in accordance with Article 17. The combined Design-Builder Construction Management Fee, Bonds & Insurance, Design-Builder Contingency, and Project Reserve (if any) will be shown on the Schedule of values as separate lines. The values for the Design-Builder Contingency and Project Reserve (if any) will move to appropriate lines within the Cost of the Work as those funds are committed and expended. This schedule of values will be submitted to & approved by the Project Designer and Owner within 30 days of the Notice to Proceed. The schedule of values shall be prepared in such form and supported by such data to substantiate its accuracy as the Owner may require.
- d. Applications for payment shall be in a form agreed upon by the Design-Builder, and Owner and shall prepared and supported by such data to substantiate the accuracy of the request as the Owner may require.
- e. Subject to other provisions of the contract documents, the amount of each progress payment shall be computed as follows:
 1. Take that portion of the GMP properly allocable to completed work as determined by multiplying the percentage completion of each portion Cost of the Work by the share of the GMP allocated to that portion of the work in the schedule of values.

2. Add that portion of the GMP properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the work or if approved in advance by the Owner, suitably stored off site at a location agreed upon in writing.
 3. Subtract the aggregate of previous payments made by the Owner.
 4. Subtract the amount, in any, by which the Design-Builder has been previously overpaid, as evidenced by the Owner's review of the Design-Builder's documentation.
 5. Subtract amounts, if any, for which the Owner has withheld or nullified a certificate of payment.
 6. Subtract retainage as per paragraph (h) below.
 7. Add the amount due for the Design-Builder Fee calculated on the basis the percentage completion of the project or on a schedule of payment negotiated with the Owner less fifteen percent (15%) and less previous payments for Design-Builder Fee.
- f. Payment allocated to Principal Trade and Specialty Contractors shall be subject to five percent (5%) retainage, provided, however that after fifty percent (50%) of the Cost of the Work has been satisfactorily completed on schedule, with the approval of the Owner and the State Construction Office and with written consent of the surety, further requirements for retainage will be waived only so long as work continues to be completed satisfactorily and on schedule. The balance of the Design-Builder Fee shall be held by the Owner until satisfactory completion and close out of the project. Satisfactory completion and close out of the project means that the Owner and Project Design-Builder are satisfied that the project has been completed in accordance with the plans and specifications and within the GMP, all general conditions of the contract pertaining to close out have been satisfied, and all Principal Trade and Specialty Contractors have satisfactorily completed their respective contracts. No retainage will be held for the cost of Bonds and Insurance
- g. Except with the Owner's prior approval, the Design-Builder shall not make advance payments to suppliers for materials or equipment, which has not been delivered and stored at the site.
- h. The Project Designer shall take action on the Design-Builder's application for payment in accordance with the Agreement between the Design Builder and Project Designer. The Project Designer's certification for payment shall be based upon the Project Designer's on-site inspection and the documentation submitted by the Design-Builder with the application for payment.

ARTICLE 32 - CERTIFICATES OF PAYMENT AND FINAL PAYMENT

- a. Within five (5) days from receipt of request for payment from the Design-Builder, the Project Designer shall issue and forward to the Owner a certificate for payment. This certificate shall indicate the amount requested or as approved by the Project Designer. If the certificate is not approved by the Project Designer, he shall state in writing to the Design-Builder and the Owner his reasons for withholding payment.
- b. No certificate issued or payment made shall constitute an acceptance of the work or any part thereof. The making and acceptance of final payment shall constitute a waiver of all claims by the Owner except:
 1. Claims arising from unsettled liens or claims against the Design-Builder.

2. Faulty work or materials appearing after final payment.
 3. Failure of the contractor to perform the work in accordance with drawings and specifications, such failure appearing after payment.
 4. As conditioned in the performance bond and payment bond.
- c. The making and acceptance of final payment shall constitute a waiver of all claims by the Design-Builder except those claims previously made and remaining unsettled (Article 20(c)).
 - d. Prior to submitting request for final payment to the Project Designer for approval, the Design-Builder shall fully comply with all requirements specified in the "project closeout" section of the specifications. These requirements include but not limited to the following:
 1. Submittal of Product and Operating Manuals, Warranties and Bonds, Guarantees, Maintenance Agreements, As-Built Drawings, Certificates of Inspection or Approval from agencies having jurisdiction. (The Project Designer must approve the Manuals prior to delivery to the Owner).
 2. Transfer of required attic stock material and all keys in an organized manner.
 3. Record of Owner's training.
 4. Resolution of any final inspection discrepancies.
 - e. The Design-Builder shall forward to the Project Designer, the final application for payment along with the following documents:
 1. List of minority business subcontractors and material suppliers showing breakdown of contracts amount.
 2. Affidavit of Release of Liens.
 3. Affidavit from Design-Builder of payment to material suppliers and subcontractors. (See Article 36).
 4. Consent of Surety to Final Payment.
 5. Certificates of state agencies required by state law.
 - f. The Project Designer will not authorize final payment until the work under contract has been certified by Project Designer, certificates of compliance issued, and the Design-Builder has complied with the closeout requirements. The Project Designer shall forward the Design-Builder's final application for payment to the Owner along with respective certificate(s) of compliance required by law.

ARTICLE 33 - PAYMENTS WITHHELD

- a. The Owner with the approval of the State Construction Office may withhold payment for the following reasons:
 1. Faulty work not corrected.

2. The unpaid balance on the contract is insufficient to complete the work in the judgment of the designer.
 3. To provide for sufficient contract balance to cover liquidated damages that will be assessed against the Design-Builder.
- b. The Secretary of the Department of Administration may authorize the withholding of payment for the following reasons:
1. Claims filed against the Design-Builder or evidence that a claim will be filed.
 2. Evidence that Principal Trade or Specialty Contractors have not been paid.
- c. When grounds for withholding payments have been removed, payment will be released. Delay of payment due the Design-Builder without cause will make Owner liable for payment of interest to the contractor as provided in N.C.G.S. 143-134.1.

ARTICLE 34 - MINIMUM INSURANCE REQUIREMENTS

The work under this contract shall not commence until the Design-Builder has verified to the Owner that all required insurance and verifying certificates of insurance have been obtained and approved in writing by the Owner. These certificates shall contain a provision that coverage's afforded under the policies will not be cancelled, reduced in amount or coverage's eliminated until at least thirty (30) days after mailing written notice, by certified mail, return receipt requested, to the insured and the Owner of such alteration or cancellation.

a. Worker's Compensation and Employer's Liability

The Design-Builder shall ensure that it and all Principal Trade and Specialty Contractors shall provide and maintain, during the life of the contract, workmen's compensation insurance, as required by law, as well as employer's liability coverage with minimum limits of \$100,000.

b. Public Liability and Property Damage

The Design-Builder shall ensure that it and all Principal Trade and Specialty Contractors shall provide and maintain, during the life of the contract, comprehensive general liability insurance, including coverage for premises operations, independent contractors, completed operations, products and contractual exposures, as shall protect such contractors from claims arising out of any bodily injury, including accidental death, as well as from claims for property damages which may arise from operations under this contract, whether such operations be by the contractor or by any subcontractor, or by anyone directly or indirectly employed by either of them and the minimum limits of such insurance shall be as follows:

Bodily Injury Liability: \$1,000,000 for each person and \$1,000,000 for each accident
 Property Damage Liability: \$1,000,000 for each accident and \$3,000,000 for the aggregate of operations

In lieu of limits listed above, a \$3,000,000 combined single limit shall satisfy both conditions.

Such coverage for completed operations must be maintained for at least two (2) years following final acceptance of the work performed under the contract.

c. Property Insurance (Builder's Risk/Installation Floater)

The Design-Builder shall ensure that it and all Principal Trade and Specialty Contractors shall purchase and maintain property insurance during the life of this contract, upon the entire work at the site to the full insurable value thereof. This insurance shall include the interests of the Owner, the Design-Builder, and subcontractors in the work and shall insure against the perils of fire, extended coverage, and vandalism and malicious mischief. If the Owner is damaged by failure of the Design-Builder to purchase or maintain such insurance, then the Design-Builder shall bear all reasonable costs properly attributable thereto; the Design-Builder shall effect and maintain similar property insurance on portions of the work stored off the site when request for payment per articles so includes such portions.

d. Deductible

Any deductible, if applicable to loss covered by insurance provided, is to be borne by the Design-Builder.

e. Other Insurance

The Design-Builder shall ensure that it and all Principal Trade and Specialty Contractors shall obtain such additional insurance as may be required by the Owner or by the General Statutes of North Carolina including motor vehicle insurance, in amounts not less than the statutory limits.

f. Proof of Carriage

The Design-Builder shall ensure that it and all Principal Trade and Specialty Contractors shall furnish the Owner with satisfactory proof of carriage of the insurance required before written approval is granted by the Owner.

g. Professional Liability

The Project Designer, which includes the prime designer and all his consultants on the Design-Build team, shall each carry a minimum of \$3,000,000 of professional liability.

ARTICLE 35 - PERFORMANCE BOND AND PAYMENT BOND

- a. The Design-Builder shall furnish a performance bond and payment bond executed by a surety company authorized to do business in North Carolina. The bonds shall be in the full contract amount, which shall be in the amount of the GMP for the entire project. Bonds shall be executed in the form bound with the specifications
- b. All bonds shall be countersigned by an authorized agent of the bonding company who is licensed to do business in North Carolina.

ARTICLE 36 - CONTRACTOR'S AFFIDAVIT

The final payment of retained amount due the Design-Builder on account of the contract shall not become due until the Design-Builder has furnished to the Owner through the Project Designer an affidavit signed, sworn and notarized to the effect that all payments for materials, services or subcontracted work to Principal Trade and Specialty Contractors in connection with his contract have been satisfied, and that no claims or liens exist against the Design-Builder in connection with this contract. In the event that the Design-Builder cannot obtain similar affidavits from the Principal Trade and Specialty Contractors to protect the Design-Builder and the Owner from

possible liens or claims against the subcontractor, the Design-Builder shall state in his affidavit that no claims or liens exist against any subcontractor to the best of his (the Design-Builder's) knowledge, and if any appear afterward, the Design-Builder shall save the Owner harmless.

ARTICLE 37 - ASSIGNMENTS

The Design-Builder shall not assign any portion of this contract nor subcontract in its entirety. Except as may be required under terms of the performance bond or payment bond, no funds or sums of money due or become due the Design-Builder under the contract may be assigned.

ARTICLE 38 - USE OF PREMISES

- a. The Design-Builder shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the Owner and shall not exceed those established limits in his operations.
- b. The Design-Builder shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.
- c. The Design-Builder shall enforce the Owner's instructions regarding signs, advertisements, fires and smoking.
- d. No firearms, any type of alcoholic beverages or drugs (other than those prescribed by a physician) will be permitted at the job site.

ARTICLE 39 - CUTTING, PATCHING AND DIGGING

- a. The Design-Builder shall ensure that all cutting, fitting or patching that may be required to make the work come together properly and fit it to receive or be received by work of other contractors shown upon or reasonably implied by the drawings and specifications for the completed structure, as the Project Designer may direct.
- b. Any cost brought about by defective or ill-timed work shall be borne by the party responsible therefor.
- c. No Principal Trade or Specialty Contractor shall endanger any work of another such contractor by cutting, digging or other means, nor shall he cut or alter the work of any other such contractor without the consent of the Design-Builder and the affected contractor(s).

ARTICLE 40 - UTILITIES, STRUCTURES, SIGNS

- a. The Design-Builder shall provide necessary and adequate facilities for water, electricity, gas, oil, sewer, and other utility services, which may be necessary and required for completion of the project. If the Owner specifies that the Design-Builder is to pay all utilities, any permanent meters installed shall be listed in the Design-Builder's name until his work is fully accepted by the Owner. As stipulated in the Supplementary General Conditions, the Owner may: (1) pay utilities cost directly, (2) require the Design-Builder to pay all utilities cost, (3) or reimburse the Design-Builder for the actual cost of utilities. The Owner or Design-Builder, as applicable, may recover actual costs of metered utilities from the responsible party should delays occur in project completion.
- b. If applicable Meters shall be relisted in the Owner's name on the day following completion and acceptance of the Design-Builder's work, and the Owner shall pay for services used after that date.

- c. {NOT USED}
- d. Prior to the operation of permanent systems, the Design-Builder will provide temporary power, lighting, water, and heat to maintain space temperature above freezing, as required for construction operations.
- e. The Design-Builder shall have the permanent building systems in sufficient readiness for furnishing temporary climatic control at the time a building is enclosed and secured. The HVAC systems shall maintain climatic control throughout the enclosed portion of the building sufficient to allow completion of the interior finishes of the building. A building shall be considered enclosed and secured when windows, doorways (exterior, mechanical, and electrical equipment rooms), and hardware are installed; and other openings have protection, which will provide reasonable climatic control. The appropriate time to start the mechanical systems and climatic condition shall be jointly determined by the Design-Builder and the owner. Use of the equipment in this manner shall in no way affect the warranty requirements of the Design-Builder.
- f. The Design-Builder shall coordinate the work so that the building's permanent power wiring distribution system shall be in sufficient readiness to provide power as required by the HVAC contractor for temporary climatic control.
- g. The Design-Builder shall coordinate the work so that the building's permanent lighting system shall be ready at the time interior painting and finishing begins and shall provide adequate lighting in those areas where interior painting and finishing is being performed.
- h. The Design-Builder shall be responsible for his permanently fixed service facilities and systems in use during progress of the work. The following procedures shall be strictly adhered to:
 - 1. Prior to acceptance of work by the Owner, the Design-Builder shall coordinate the removal and replacement of any parts of the permanent building systems damaged through use during construction.
 - 2. Temporary filters shall be installed in each of the heating and air conditioning units and at each return grille during construction. New filters shall be installed in each unit prior to the Owner's acceptance of the work.
 - 3. Extra effort shall be maintained to keep the building and the site adjacent to the building clean and under no circumstances shall air systems be operated if finishing and site work operations are creating dust in excess of what would be considered normal if the building were occupied.
 - 4. It shall be understood that any warranty on equipment presented to the Owner shall extend from the day of final acceptance by the Owner. The cost of warranting the equipment during operation in the finishing stages of construction shall be borne by the contractor whose system is utilized.
 - 5. The Design-Builder shall ensure that all lamps are in proper working condition at the time of final project acceptance.
- i. The Design-Builder shall provide, if required and where directed, a shed for toilet facilities and shall furnish and install in this shed all water closets required for a complete and adequate

sanitary arrangement. These facilities will be available to other contractors on the job and shall be kept in a neat and sanitary condition at all times. Chemical toilets are acceptable.

- j. The Design-Builder shall, if required by the Supplementary General Conditions and where directed, erect a temporary field office, complete with lights, telephone, heat and air conditioning. A portion of this office shall be partitioned off, of sufficient size, for the use of a resident inspector, should the designer so direct.
- k. On multi-story construction projects, the Design-Builder shall either provide or ensure that temporary elevators, lifts, or other necessary special equipment is available for the general use of all contractors. The cost for such elevators, lifts or other special equipment and the operation thereof shall be included as part of the work of a Principal Trade or Specialty Contractor and paid for as a part of the Cost of the Work.
- l. The Design-Builder will erect one sign on the project if required. The sign shall be of sound construction, and shall be neatly lettered with black letters on white background. The sign shall bear the name of the project, and the Design-Builder's name, and the name of the Project Designer and consultants. Directional signs may be erected on the Owner's property subject to approval of the Owner with respect to size, style and location of such directional signs. Such signs may bear the name of the contractor and a directional symbol. No other signs will be permitted except by permission of the Owner.

ARTICLE 41 - CLEANING UP

- a. The Design-Builder shall ensure that the building and surrounding area is reasonably free from rubbish at all times, and shall remove debris from the site on a timely basis or when directed to do so by the Owner. The Design-Builder shall provide an on-site refuse container(s) for the use of all Principal Trade and Specialty Contractors. The Design-Builder shall ensure that each Principal Trade and Specialty Contractor removes their rubbish and debris from the building on a daily basis. The Design-Builder shall ensure that the building is broom cleaned as required to minimize dust and dirt accumulation.
- b. The Design-Builder shall provide and maintain suitable all-weather access to the building.
- c. Before final inspection and acceptance of the building, the Design-Builder shall ensure that all portions of the work are clean, including glass, hardware, fixtures, masonry, tile and marble (using no acid), clean and wax all floors as specified, and completely prepare the building for use by the Owner, with no cleaning required by the Owner.

ARTICLE 42 - GUARANTEE

- a. The Design-Builder shall unconditionally guarantee materials and workmanship against patent defects arising from faulty materials, faulty workmanship or negligence for a period of twelve (12) months following the date of final acceptance of the work or beneficial occupancy and shall replace such defective materials or workmanship without cost to the Owner.
- b. Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material. The Design-Builder shall replace such defective equipment or materials, without cost to the Owner, within the manufacturer's warranty period.
- c. Additionally, the Owner may bring an action for latent defects caused by the negligence of the Design-Builder, which is hidden or not readily apparent to the Owner at the time of

beneficial occupancy or final acceptance, whichever occurred first, in accordance with applicable law.

- d. Guarantees for roof, equipment, materials, and supplies shall be stipulated in the specifications sections governing such roof, equipment, materials, or supplies.

ARTICLE 43 - CODES AND STANDARDS

Wherever reference is given to codes, standard specifications or other data published by regulating agencies including, but not limited to, national electrical codes, North Carolina State Building Codes, federal specifications, ASTM specifications, various institute specifications, etc., it shall be understood that such reference is to the latest edition including addenda published prior to the date of the contract documents.

ARTICLE 44 - INDEMNIFICATION

To the fullest extent permitted by law, the Design-Builder shall indemnify and hold harmless the Owner, and the agents, consultants and employees of the Owner, from and against all claims, damages, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance or failure of performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the work itself) including the loss of use resulting therefrom, and (2) is caused in whole or in part by any negligent act or omission of the Design-Builder, the Design-Builder's subcontractor, or the agents of either the Design-Builder. Such obligation shall not be construed to negate, abridge or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this article.

ARTICLE 45 - TAXES

- a. Federal excise taxes do not apply to materials entering into state work (Internal Revenue Code, Section 3442(3)).
- b. Federal transportation taxes do not apply to materials entering into state work (Internal Revenue Code, Section 3475(b) as amended).
- c. North Carolina sales tax and use tax, as required by law, do apply to materials entering into state work and such costs shall be included in the bid proposal and contract sum.
- d. Local option sales and use taxes, as required by law, do apply to materials entering into state work as applicable and such costs shall be included in the bid proposal and contract sum.
- e. Accounting Procedures for Refund of County Sales & Use Tax

Amount of county sales and use tax paid per Design-Builder's statements:

Design-Builder's performing contracts for state agencies shall ensure that the Principal Trade and Specialty Contractors provide information to allow the Design-Builder to give the state agency for whose project the materials, supplies, fixtures and/or equipment was purchased a signed statement containing the information listed in N.C.G.S. 105-164.14(e).

The Department of Revenue has agreed that in lieu of obtaining copies of sales receipts from contractors, an agency may obtain a certified statement as of April 1, 1991 from the contractor

setting forth the date, the type of property and the cost of the property purchased from each vendor, the county in which the vendor made the sale and the amount of local sales and use taxes paid thereon. If the property was purchased out-of-state, the county in which the property was delivered should be listed. The contractor should also be notified that the certified statement may be subject to audit.

In the event the contractors make several purchases from the same vendor, such certified statement must indicate the invoice numbers, the inclusive dates of the invoices, the total amount of the invoices, the counties, and the county sales and use taxes paid thereon.

Name of taxing county: The position of a sale is the retailer's place of business located within a taxing county where the vendor becomes contractually obligated to make the sale. Therefore, it is important that the county tax be reported for the county of sale rather than the county of use.

When property is purchased from out-of-state vendors and the county tax is charged, the county should be identified where delivery is made when reporting the county tax.

Such statement must also include the cost of any tangible personal property withdrawn from the contractor's warehouse stock and the amount of county sales or use tax paid thereon by the Design-Builder.

Contractors are not to include any tax paid on supplies, tools and equipment which they use to perform their contracts and should include only those building materials, supplies, fixtures and equipment which actually become a part of or annexed to the building or structure.

ARTICLE 46 - EQUAL OPPORTUNITY CLAUSE

The non-discrimination clause contained in Section 202 (Federal) Executive Order 11246, as amended by Executive Order 11375, relative to equal employment opportunity for all persons without regard to race, color, religion, sex or national origin, and the implementing rules and regulations prescribed by the Secretary of Labor, are incorporated herein.

ARTICLE 47 - EMPLOYMENT OF THE HANDICAPPED

The Design-Builder agrees not to discriminate against any employee or applicant for employment because of physical or mental handicap in regard to any position for which the employee or applicant is qualified. The Design-Builder agrees to take affirmative action to employ, advance in employment and otherwise treat qualified handicapped individuals without discrimination based upon their physical or mental handicap in all employment practices.

ARTICLE 48 - ASBESTOS-CONTAINING MATERIALS (ACM)

The State of North Carolina has attempted to address all asbestos-containing materials that are to be disturbed in the project. However, there may be other asbestos-containing materials in the work areas that are not to be disturbed and do not create an exposure hazard. Construction Managers are reminded of the requirements of instructions under General Conditions of the Contract, titled Examination of Conditions. Statute 130A, Article 19, amended August 3, 1989, established the Asbestos Hazard Management Program that controls asbestos abatement in North Carolina. The latest edition of *Guideline Criteria for Asbestos Abatement* from the State Construction Office is to be incorporated in all asbestos abatement projects for the Capital Improvement Program. Design-Builder shall be responsible to have all areas that will be impacted by the construction tested for ACM and removed per federal and state laws, criteria and guidelines.

ARTICLE 49 - MINORITY BUSINESS PARTICIPATION

N.C.G.S. 143-128.2 establishes a ten percent (10%) goal for participation by minority businesses in total value of work for each State building project and requires documentation of good faith efforts for meeting that goal. The document, *Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts* including Affidavits and Appendix F are hereby incorporated into and made a part of this contract.

The Owner shall require the Design-Builder to submit a plan for compliance with N.C.G.S.143-128.2 by approval by the Owner prior to soliciting bids for the Principal Trade and Specialty Contracts. The Design-Builder and Principal Trade and Specialty Contractors shall make a good faith effort to recruit and select minority businesses for participation in contracts pursuant to N.C.G.S. 143-128.2.

ARTICLE 50 – CONTRACTOR EVALUATION

The Design-Builder's overall work performance on the project shall be fairly evaluated in accordance with the State Building Commission policy and procedures, for determining qualifications to compete for future capital improvement projects for institutions and agencies of the State of North Carolina. In addition to final evaluation, interim evaluation may be prepared during the progress of project. The document, *Construction Manager Evaluation Procedures*, is hereby incorporated and made a part of this contract. The Owner may request the Design-Builder's comments to evaluate the Project Designer.

ARTICLE 51 – GIFTS

N.C.G.S. 133-32 and Executive Order 24 prohibit the offer to, or acceptance by, any state employee of any gift from anyone with a contract with the state, or from any person seeking to do business with the State. By execution of any response in this contract, you attest, for your entire organization and its employees or agents, that you are not aware that any such gift has been offered, accepted, or promised by any employees of your organization.

ARTICLE 52 – AUDITING-ACCESS TO PERSONS AND RECORDS

In accordance with N.C. General Statute 147-64.7, the State Auditor shall have access to Design-Builder's officers, employees, agents and/or other persons in control of and/or responsible for the Design-Builder's records that relate to this contract for purposes of conducting audits under the referenced statute. The Owner's internal auditors shall also have the right to access and copy the Design-Builder's records relating to the contract and project during the term of the contract and within two years following the completion of the project/close-out of the contract to verify accounts, accuracy, information, calculations and/or data affecting and/or relating to Design-Builder's requests for payment, requests for change orders, change orders, claims for extra work, requests for time extensions and related claims for delay/extended general conditions costs, claims for lost productivity, claims for loss efficiency, claims for idle equipment or labor, claims for price/cost escalation, pass-through claims of subcontractors and/or suppliers, and/or any other type of claim for payment or damages from Owner and/or its project representatives.

ARTICLE 53 – NORTH CAROLINA FALSE CLAIMS ACT

The North Carolina False Claims Act (“NCFCA”), N.C Gen. Stat. § 1-605 through 1-618, applies to this contract. The Design-Builder should familiarize itself with the entire NCFCA and should seek the assistance of an attorney if it has any questions regarding the NCFCA and its applicability to any requests, demands and/or claims for payment its submits to the State through the contracting state agency, institution, university or community college. The purpose of the NCFCA “is to deter persons from knowingly causing or assisting in causing the State to pay claims that are false or fraudulent and to provide remedies in the form of treble damages and civil penalties when money is obtained from the State by reason of a false or fraudulent claim.” (Section 1-605(b).) A Design-Builder’s liability under the NCFCA may arise from, but is not limited to: requests for payment, invoices, billing, claims for extra work, requests for change orders, requests for time extensions, claims for delay damages/extended general conditions costs, claims for loss productivity, claims for loss efficiency, claims for idle equipment or labor, claims for price/cost escalation, pass-through claims of subcontractors and/or suppliers, documentation used to support any of the foregoing requests or claims, and/or any other request for payment from the State through the contracting state agency, institution, university or community college. The parts of the NCFCA that are most likely to be enforced with respect to this type of contract are as follows:

A “claim” is “[a]ny request or demand, whether under a contract or otherwise, for money or property and whether or not the State has title to the money or property that (i) is presented to an officer, employee, or agent of the State or (ii) is made to a contractor ... if the money or property is to be spent or used on the State's behalf or to advance a State program or interest and if the State government: (a) provides or has provided any portion of the money or property that is requested or demanded; or (b) will reimburse such contractor ... for any portion of the money or property which is requested or demanded.” (Section 1-606(2).)

"Knowing" and "knowingly." – Whenever a person, with respect to information, does any of the following: (a) Has actual knowledge of the information; (b) Acts in deliberate ignorance of the truth or falsity of the information; and/or (c) Acts in reckless disregard of the truth or falsity of the information. (Section 1-606(4).) Proof of specific intent to defraud is not required. (Section 1-606(4).)

"Material" means having a natural tendency to influence, or be capable of influencing, the payment or receipt of money or property. (Section 1-606(4).)

Liability. – “Any person who commits any of the following acts shall be liable to the State for three times the amount of damages that the State sustains because of the act of that person[:] ... (1) Knowingly presents or causes to be presented a false or fraudulent claim for payment or approval. (2) Knowingly makes, uses, or causes to be made or used, a false record or statement material to a false or fraudulent claim. (3) Conspires to commit a violation of subdivision (1), (2) ...” (Section 1-607(a)(1), (2).)

The NCFCA shall be interpreted and construed so as to be consistent with the federal False Claims Act, 31 U.S.C. § 3729, et seq., and any subsequent amendments to that act. (Section 1-616(c).)

Finally, the contracting state agency, institution, university or community college may refer any suspected violation of the NCFCA by the Design-Builder to the Attorney General's Office for investigation. Under Section 1-608(a), the Attorney General is responsible for investigating any violation of NCFCA, and may bring a civil action against the Design-Builder under the NCFCA. The Attorney General's investigation and any civil action relating thereto are independent and not subject to any dispute resolution provision set forth in this contract. (See Section 1-608(a).)

ARTICLE 54 – TERMINATION FOR CONVENIENCE

Owner may at any time and for any reason terminate Design-Builder's services and work at Owner's convenience. Upon receipt of such notice, Design-Builder shall, unless the notice directs otherwise, immediately discontinue the work and placing of orders for materials, facilities and supplies in connection with the performance of this Agreement. Upon such termination, Design-Builder shall be entitled to payment only as follows: (1) the actual cost of the work completed in conformity with this Agreement; plus, (2) such other costs actually incurred by Design-Builder as are permitted by the prime contract and approved by Owner; (3) plus ten percent (10%) of the cost of the work referred to in subparagraph (1) above for overhead and profit. There shall be deducted from such sums as provided in this subparagraph the amount of any payments made to Design-Builder prior to the date of the termination of this Agreement. Design-Builder shall not be entitled to any claim or claim of lien against Owner for any additional compensation or damages in the event of such termination and payment.

ARTICLE 55 – DESIGN REQUIREMENTS OF DESIGN-BUILDER

Schematic Design

- 1-1 The Designer shall consult with the Owner to ascertain the requirements of the project and shall confirm such requirements to the Owner.
- 1-2 He shall prepare schematic design studies (see State Construction Manual), leading to a recommended solution together with a general description of the project for approval by the Owner.
- 1-3 Design-Builder shall submit to the Owner a statement of probable construction cost based on the area, volume or other current unit costs. (See State Construction Manual.)

Design Development

- 1-4 The Designer shall prepare from the approved schematic design studies, for approval by the Owner, the design development documents which shall include site and floor plans, elevations and other drawings, and outline specifications as are necessary to fix and illustrate the size and character of the entire project in its essentials as to kinds of material, type of structure, mechanical and electrical systems, and such other work as may be required, including site and utility requirements.

- 1-5 Design-Builder shall submit to the Owner a further statement of probable construction cost. (See State Construction Manual.)

Construction Document

- 1-6 The Designer shall prepare from the approved design development documents, working drawings and specifications setting forth in detail and prescribing the work to be done and the materials, workmanship, finishes and equipment required for the engineering, architectural, structural, mechanical, electrical and the site work, and for service-connected equipment; and assemble the necessary bidding information, proposal and contract forms, and conditions of the contract, for approval by the Owner. (See State Construction Manual.)
- 1-7 Design-Builder shall submit to the Owner a further statement of probable construction cost as indicated by fully developed requirements and current market conditions. (See State Construction Manual.)
- 1-8 The Design-Builder shall prepare and file the required documents for the approval of governmental authorities having jurisdiction over the project.

Construction

- 1-9 The designer's responsibilities during Construction shall be as described in State Construction Manual, and as set forth hereinafter. His responsibilities shall include the following:
- a) Process and approve, or take other appropriate action in respect of, progress schedules, shop drawings and other required submissions of contractors promptly;
 - b) Process contractors' applications for payment promptly for authorized work and issue certificates of payment;
 - c) Review "MBE Documentation for Contract Payment" – (Appendix E) for compliance with minority business utilization commitments. Submit Appendix E form with monthly pay applications to the Owner and forward copies to the State Construction Office.
 - d) Provide general administration of the performance of construction contracts, including inspection and continuous liaison of the work to ensure compliance with plans and specifications, which inspection shall be by qualified and mutually agreed upon representatives of the designer's firm not less than once per week while work is in progress, and as often as necessary to ensure compliance with plans and specifications;
 - e) Require all in-house consultants and contract consultants participating in the design of the project, and as named in Article 13 of this contract, to provide liaison and inspection services with respect to their portion of the design not less than once per week while work related to their design is in progress and as often as necessary to ensure compliance with plans and specifications;

- f) Schedule and conduct final inspection of the project, coordinating the date for such inspection with the Owner and with the State Construction Office;
 - g) Assemble written guarantees, affidavits, manuals of instruction for operation, and other required and closing papers of the contractors; issue certificates of final completion, certificates of compliance from various in-house and contract consultants as required by G.S. 133-1.1, final certificates for payment; and set date for beginning of the guarantee period, forwarding all closing papers to the Owner;
- 1-10 The Designer agrees that his representatives on the construction project shall be qualified by training and experience to make decisions and interpretations of plans and specifications, and shall be empowered by the Designer to do so; such decisions and interpretations shall be binding upon the Designer as if made by him; all such decisions shall be confirmed in writing at the earliest reasonable date, with copies to the Owner and the State Construction Office, conditioned that such decisions and interpretations shall not modify adversely the requirements of the contract documents; the designer's representatives shall be replaced promptly and without protest at the request of the Owner, if in the opinion of the Owner and the State Construction Office, such representatives are either negligent or unqualified to perform their duties; and all of the above in this paragraph shall be applicable to consultants referred to in Paragraph 1-14(h) above.

Post-Construction Phase

- 1-11 Upon completion of the project, the Designer shall correct the drawings to conform to the project as finally constructed, and shall deliver to the Owner and to the State Construction Office corrected record drawings.
- 1-12 Prior to final payment to the Designer, he shall prepare and deliver to the Owner and to the State Construction Office a final report. (See State Construction Manual.)
- 1-13 Five percent (5%) of the total fee of the Designer shall be retained until approval of the record drawings and final report by the State Construction Office and the Owner. Final payment can be made after letter of approval is received by the Owner from the State Construction Office.

Additional Services

- 1-14 In the event the Owner, with the approval of the State Construction Office, requests in writing that the Designer perform services over, above and beyond the basic services described in Article 1 hereof, then the Designer may be paid for such additional services as herein before provided. Additional services, for which additional compensation may be allowed, are as described hereinafter.

- a) Revising previously approved design development or working drawings or specifications to accomplish changes ordered by the Owner, except where required to get the cost within the total project budget;
- b) Preparing drawings and specifications for alternate bids for work beyond the scope of that originally contemplated in this Agreement; (when alternates are used to assure keeping project within the total project budget, no additional fee shall apply);
- c) Making an inspection of the project prior to expiration of the guarantee period and reporting observed discrepancies under guarantees provided by the construction contracts;
- d) Other services as may be required will be negotiated.

Cost Limitations

- 1-15 The total project cost, as indicated in the contract, is derived from a specific appropriation or funds specifically provided for the particular project. Accordingly, the Designer shall conform his plans to a design, the construction cost of which together with the addition of design fees, shall not exceed the total project cost.
- 1-16 In the event that during the several stages of development of his plans the Design-Builder's Statement of Probable Construction Cost together with design fees exceeds the limitations set forth, the Owner shall have the right to require the Designer, without any additional cost to the Owner, to modify his plans and specifications or redesign the project as may be necessary to bring the construction cost plus design fees within the Total Project Cost.

Ownership of Plans and Specifications

- 1-17 All designs, drawings, specifications, design calculations, notes and other works developed in the performance of this contract shall become the sole property of the State of North Carolina and may be used on any other design or construction without additional compensation to the Designer. The use of the design, including tracings and specifications, by any person or entity, for the purpose other than the project, shall be at the full risk of such person or entity and the Designer shall be relieved of any liability whatsoever, including claims for personal injury, property damage, or death as a result of such other use.

UNCW Parking Deck II Supplementary General Conditions

1. ARTICLE 1 – DEFINITIONS

- a. Paragraph a: Add the following to the end of the paragraph: "The Geotechnical Technical Report does not constitute part of the Contract Documents, but is included for reference."
- b. Paragraph c: Add "the Designers are Clark Nexsen, Walker Parking, and McKim & Creed".
- c. Paragraph h: Add "the project name is UNCW Parking Deck II and Surface Parking"
- d. Paragraph i.1: Revise Design Services Article reference of "Article 15 to Article 55" per SCO
- e. Paragraph m: Add "The Liquidated Damages are \$1,000 per day"
- f. Add the following new paragraph. "

"u. Project Identification: All correspondence, reports, schedules, applications for payment, fax items, etc. shall contain proper title of project, code, item and SCO ID numbers, typical."
- g. Add the following new paragraph:

"v. Latest edition" shall mean the current printed version of the referenced document issued up to 30 calendar days prior to date of receipt of bids, unless specified otherwise."
- h. Add the following new paragraph:

"w. 'Drawings' or 'plans' shall mean the drawings enumerated in the contract documents, as well as all the information in the detail manual (when applicable), addenda, and designer-prepared field drawings and clarification drawings."
- i. Add the following new paragraph:

"x. 'Specifications' mean this project manual and addenda thereto."

2. ARTICLE 2 – INTENT AND EXECUTION OF DOCUMENTS

- a. Paragraph a: Add the following new sub-paragraphs:
 - 1. The drawings and specifications represent the general dimensional and aesthetic requirements for various "in place" materials required to produce a Precast Parking Deck acceptable to the owner for his intended use
 - 2. It is the intent of the drawings and specifications to provide a Precast Parking Deck and associated appurtenances that are structurally sound and conforming to at least the minimum requirements of the North Carolina State Building Code.
 - 3. The Design Builder shall make all reasonable efforts to achieve this intent. If any detail shown on these drawings appears inconsistent with this intent, in the opinion of the Contractor, he shall notify the Designer in writing of his opinion, and await instructions from the Designer before proceeding with the work.

UNCW Parking Deck II Supplementary General Conditions

4. Where more detailed information is needed, or when an interpretation of the contract documents is required, the Contractor shall refer the matter in writing to the Designer prior to proceeding with the work. The Designer shall furnish the Contractor an interpretation in writing.

5. If the Design Builder discovers errors, inconsistencies, discrepancies or omissions in the contract documents, the Contractor shall inform the Designer of such condition prior to proceeding with the work.

3. ARTICLE 5 – SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA

a. Add the following new paragraph:

“d. This schedule must account for any resubmittals required to obtain approval from the Project Designer and Owner.”

b. Add the following new paragraph:

“e. No time extension will be granted for delays caused due to failure of the Contractor to properly review shop drawings prior to submittal to the Project Designer. All shop drawings shall indicate how materials relate to conditions of the project. Standard manufacturer's drawings that do not show how and where material is to be used will not be reviewed by the Project Designer. Shop drawings shall not be reproductions of contract documents. Coordination drawings are required in accordance with Article 14.”

4. ARTICLE 8 – MATERIALS, EQUIPMENT, EMPLOYEES

a. Add the following new paragraph:

“h. All construction personnel shall be respectful to all University of North Carolina Wilmington staff and students. Any disrespect, harassment, unwelcome comments or advances from any construction personnel toward any staff member or student shall constitute sufficient grounds for University of North Carolina Wilmington to request removal of any specific individuals from this project. Such action taken by the Owner shall not constitute grounds for a delay claim. The Owner will not be responsible for any delays caused to the project due to any individual being removed from the project. Project superintendents shall be held accountable for any incident of this nature.”

5. ARTICLE 10 – PERMITS, INSPECTIONS, FEES, REGULATIONS

a. Add the following new paragraph:

“e. Notify UNCW EH&S a minimum of one day in advance prior to performing work requiring a Hot Work Permit.”

6. ARTICLE 11 – PROTECTION OF WORK, PROPERTY AND THE PUBLIC

a. Add the following new paragraph:

“j. In case emergency contact is required, the Design-Builder shall furnish the Owner

UNCW Parking Deck II Supplementary General Conditions

with names, pager numbers, and telephone numbers (day and night) of the project manager and superintendent. The numbers shall remain current for the duration of the project, and shall be updated as required.”

- b. Add the following new paragraph:

“k. The Owner will provide security as it deems prudent and necessary for its own protection. The Design-Builder shall be responsible for security and safety of the project within the project limits, including on-site materials. The Design-Builder and the Owner shall meet on a regular basis as required but not less than weekly to coordinate safety and security issues.”

- c. Add the following new paragraph:

“l. The Owner will conduct normal operations during the duration of the project. Unless otherwise stated, the campus buildings will be occupied and will operate on a normal schedule. This means that the Design-Builder will be required to schedule work around regular operations, special events, visitors and staff requirements. The Design-Builder shall coordinate with the Owner's representative to minimize any disruptions to the functions of the College.”

7. ARTICLE 12 – SEDIMENTATION POLLUTION CONTROL ACT OF 1973

- a. Add the following new paragraph:

“e. The Design-Builder shall comply with the following requirements: Equipment utilized during the construction activity on a site must be operated and maintained in a manner as to prevent the potential or actual pollution of the surface or ground waters. Fuels, lubricants, coolants, and hydraulic fluids, or any other petroleum products, shall not be discharged on the ground or into surface waters. Spent fluids shall be disposed of in a manner so as not to enter the waters, surface or ground, and in accordance with applicable state and federal disposal regulations. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner so as not to allow their entry into the waters, surface or ground, storm sewers, or drains on private or public property. Herbicide, pesticide, and fertilizer usage during the construction activity shall be restricted to those Materials approved by EPA and shall be used in accordance with label instructions. All wastes composed of construction materials shall be disposed of in accordance with NC General Statutes, Chapter 130A, Article 9- Solid Waste Management, and rules governing the disposal of solid waste (NC Administrative Code Section 15A NCAC 13B).”

- b. Add the following new paragraph:

“f. Minimum Monitoring and Reporting Requirements:

1. All sedimentation and erosion control facilities shall be inspected by the Design-Builder at least once every seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period.
2. Storm water runoff discharges shall be inspected by visual observation for color, foam, outfall, staining, visible sheens, dry weather flows and muddy water (at the frequency described above) to evaluate the effectiveness of the pollution control facilities or practices. If any visible off-site sedimentation is leaving the site, corrective action shall be taken to reduce the discharge of sediments.

UNCW Parking Deck II Supplementary General Conditions

3. The Contractor shall submit to the Owner a written report of weekly inspections. Visible sedimentation found off the site shall be recorded with a brief explanation as to the measures taken to prevent future releases as well as any measures taken to clean up the sediment that has left the site. This record shall be made available to Department of Environmental Management or authorized agent upon request.”

- c. Add the following new paragraph:

“g. Maintenance and Inspections:

1. The Design-Builder shall keep all erosion controls devices and materials in good repair. The Owner reserves the right, within 24 hours prior notice to the Contractor to repair any erosion control measures or materials as required, and deduct the cost of those repairs from the Contractor’s application for payment.
2. The owner's representative may periodically evaluate the project for compliance with these requirements.”

8. ARTICLE 14 – CONSTRUCTION SUPERVISION AND SCHEDULE

- a. Delete paragraph e, and replace with the following:

“e. The Design-Builder shall employ an engineer or a land surveyor licensed in the State of North Carolina to lay out the work. The engineer or land surveyor shall establish a benchmark nearby in a location where same will not be disturbed and where direct instrument sights may be taken. In such case, the engineer or land surveyor shall coordinate the project benchmark with known campus benchmarks.”

9. ARTICLE 16 – PRINCIPAL TRADE AND SPECIALTY CONTRACTS AND CONTRACTORS

- a. Paragraph a: Per SCO since Design Build Bridging Contracting is not used, sentences 2 through 5 may be deleted

10. ARTICLE 34 – MINIMUM INSURANCE REQUIREMENTS

- a. Paragraph b: Revise minimum limits and coverage as follows:

Bodily Injury	\$1,000,000 per occurrence
Property Damage	\$1,000,000 per occurrence/\$1,000,000 aggregate, and shall include explosion, utilities, and collapse (XUC) coverage.
	\$1,000,000 Combined Single Limit to satisfy both Bodily Injury and Property Damage.

11. ARTICLE 38 – USE OF PREMISES

- a. Add the following new paragraph:

“e. Storage of construction materials shall be limited to the staging area.”

- b. Add the following new paragraph:

“f. Where equipment must cross walks, landscaping areas, or ramps, the Design-Builder

UNCW Parking Deck II Supplementary General Conditions

shall provide ¾" plywood sheets for protection of these areas. Cross walks, landscaping areas, or ramps damaged by construction activity shall be repaired or replaced."

- c. Add the following new paragraph:

"g. The construction site and staging areas as well as Owner's adjacent campus areas shall be kept free of trash, litter, and debris at all times."

- d. Add the following new paragraph:

"h. Add the following new paragraph: "Grass in the construction site shall be mowed as often as required to maintain a neat appearance. Tree protection shall extend at least to the drip line of the trees to be protected. Minimum tree protection shall include four foot landscaping fencing supported with steel stakes four foot on center. All areas under the drip line of trees are off limits to vehicular traffic unless protected by plywood."

- e. Add the following new paragraph:

"i. Landscape protection when required, shall be installed prior to the initial grading stage. No storage of any kind, access, or activity of any kind will be permitted inside the landscaping protection areas."

- f. Add the following new paragraph:

"j. A screened construction fence shall be installed. The fence shall be construction of heavy-duty chain link material, have a minimum height of six feet and it shall have a continuous top tubular rail. Swing gates shall be included at all and every access to the enclosed area."

12. ARTICLE 40 – UTILITIES, STRUCTURES, SIGNS

- a. Delete paragraph a, and replace with the following:

"a. The Design-Builder shall provide necessary and adequate facilities for water, electricity, gas, oil sewer, and other utility services which may be necessary and required for completion of the project. The University owns the water, sewer, gas, telephone and portions of the electrical utilities on campus. The Design-Builder shall arrange for and provide all appurtenances necessary for the provision of temporary services, including connections to existing utilities. Temporary telephone service shall be obtained and paid for by the Design-Builder through the University's telecommunications department. Connections for all other utilities shall be performed under the supervision of Physical Plant personnel. In all cases, the contractor shall give a minimum of 72 hours notice for the connection of all utilities.

The Design-Builder shall provide temporary electric, gas and water meters on University- owned utility services to the building. The University will read the meters on a monthly basis, and will pay for the cost of consumption for these utilities. The University reserves the right to back charge the contractor if the University finds negligence in the use of utilities.

Charges for telephone and data utilities will be charged to the contractor directly by UNCW Telecommunications Department on a monthly basis. Design-Builder is advised to confirm current telephone and data rates with UNCW Telecommunications Department (910) 962-4019."

UNCW Parking Deck II Supplementary General Conditions

- b. Delete paragraph j, and replace with the following:

“j. General Design-Builder shall provide his own office facility including telephone and facsimile machines required at location on site approved by the Owner. The Office shall be weather-tight with lighting, electrical outlets, heating, cooling equipment and equipped with sturdy furniture, drawing rack and drawing display table. The office shall also include a desk and telephone/data outlet. Design-Builder General Contractor's office shall be large enough for his own use and for use as a coordination office to include meeting space with table and chairs for 16 people. Portable toilets must be provided on site. The Owner's toilet facilities shall not be used at any time during the project.

- c. Add the following new paragraph:

“m. It is imperative that Owner's utilities and other services be maintained at all times except for scheduled interruptions. Any necessary utility interruptions shall be approved by the Owner's Representative at least three weeks in advance. If necessary, work shall be performed at night, over the weekend, or during holidays. No extra payment will be made for such work. When utility services cannot be interrupted for the length of time required, the Design-Builder shall make provisions for temporary services. Pedestrian traffic around the construction limits must be maintained in a clean and safe condition at all times.

13. ARTICLE 42 – GUARANTEE

- a. Add the following new paragraph:

“e. All warranty periods to be begin at ‘Final Acceptance’ date rather than at the ‘Substantial Completion’ date.”

14. ARTICLE 45 – TAXES

- a. Add the following new paragraph:

“f. Contractors shall submit monthly with their request for payment, a signed statement containing the amount of sales and use tax paid by the Contractor for that particular billing period on the documents included in the project specifications.

15. ARTICLE 48 – ASBESTOS-CONTAINING MATERIALS (ACM)

- a. Add the following:

“No asbestos containing material may be used in this facility, including but not limited to, sprayed-on insulation, pipe insulation, floor tile, mastic adhesive, patch materials, wiring insulation, or acoustical treatment.”

FORM OF DESIGN BUILD CONSTRUCTION CONTRACT

THIS AGREEMENT, made the _____ day of _____ in the year of
20__ by _____ and _____ between _____

hereinafter called the Party of the First Part (Design-Builder) and the State of North Carolina,
through
the _____

_____ hereinafter called
the Party of the Second Part (Owner).

WITNESSETH:

That the Party of the First Part and the Party of the Second Part for the consideration herein
named agree as follows:

1. Scope of Work:

- a. Preconstruction Phase: The Party of the First Part, in consultation direction and/or acceptance from the Party of the Second Part as stated in the General Conditions and from the defined scope of work of the project below, shall determine programmatic needs of the Party of the Second Part, furnish and deliver a complete design for the project including but not limited to architectural and engineering specifications and drawings. Design shall be reviewed and approved by all parties as outlined in the State Construction Manual but at a minimum the reviews shall consist of those of the State Construction Office and the Party of the Second Part. The Party of the First Part shall comply with all design guidelines and criteria of the State Construction Office and those of the Party of the Second Part. The Party of the First Part shall provide all required testing and exploration required for the project. The Party of the First Part shall provide a detailed cost estimate to the Party of the Second Part at each phase of design.

Project Name: _____

Interscope ID: _____

Project Scope: _____

- b. Construction Phase: The Party of the First Part shall furnish and deliver all materials, and perform all of the work in the manner and form as provided by the approved design drawings and specifications from the Preconstruction Phase, and those items not on the approved design to ensure the project is functional and complete. These plans, specifications and documents to be titled _____, are attached hereto and made a part thereof as if fully contained herein: advertisement; Instructions to Bidders; General Conditions; Supplementary General Conditions; specifications; accepted proposal; contract; performance bond; payment bond; power of attorney; workmen's compensation; public liability; property damage

and builder's risk insurance certificates; approval of attorney general; certificate by the Office of State Budget and Management.

2. That the Party of the First Part shall commence work to be performed under this agreement on a date to be specified in a written order of the Party of the Second Part and shall fully complete all work hereunder within _____ consecutive calendar days from said date. For each day in excess thereof, liquidated damages shall be as stated in General and Supplementary General Conditions. The Party of the First Part, as one of the considerations for the awarding of this contract, shall furnish to the Party of the Second Part a construction schedule setting forth planned progress of the project broken down by the various divisions or part of the work and by calendar days as outlined in Article 14 of the General Conditions of the Contract.
3. The Party of the Second Part hereby agrees to pay to the Party of the First Part for the faithful performance of this agreement, subject to additions and deductions as provided in the specifications or proposal, in lawful money of the United States as follows:

Preconstruction Phase:

 _____ (\$ _____).

Construction Phase: to be determined after completion of the Preconstruction Phase or at an earlier time at the Party of the Second Part's discretion. This cost will amended by change order to this contract.

Summary of Project Costs:

Total Project Budget:	\$ _____
Owner's Expenses/Reserves:	\$ _____
Preconstruction/Design Phase:	\$ _____
Construction Phase:	\$ <u>TBD by Change Order</u>

4. In accordance with Article 31 and Article 32 of the General Conditions of the Contract, the Party of the Second Part shall review, and if approved, process the Party of the First Party's pay request within 30 days upon receipt. The Party of the Second Part, after reviewing and approving said pay request, shall make payments to the Party of the First Part on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the First Party, less five percent (5%) of the amount of such estimate which is to be retained by the Second Party until all work has been performed strictly in accordance with this agreement and until such work has been accepted by the Second Party. The Second Party may elect to waive retainage requirements after 50 percent of the work has been satisfactorily completed on schedule as referred to in Article 31 of the General Conditions.
5. Upon submission by the First Party of evidence satisfactory to the Second Party that all payrolls, material bills and other costs incurred by the First Party in connection with the construction of the work have been paid in full, final payment on account of this agreement shall be made within thirty (30) days after the completion by the First Party of all work covered by this agreement and the acceptance of such work by the Second Party.
6. It is further mutually agreed between the parties hereto that if at any time after the execution of this agreement and the surety bonds hereto attached for its faithful

performance, the Second Party shall deem the surety or sureties upon such bonds to be unsatisfactory, or if, for any reason, such bonds cease to be adequate to cover the performance of the work, the First Party shall, at its expense, within five (5) days after the receipt of notice from the Second Party so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Second Party. In such event no further payment to the First Party shall be deemed to be due under this agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the Second Party.

7. The Party of the First Part attest that it and all of its subcontractors have fully complied with all requirements of NCGS 64 Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

IN WITNESS WHEREOF, the Parties hereto have executed this agreement on the day and date first above written in _____ counterparts, each of which shall without proof or accounting for other counterparts, be deemed an original contract.

Witness:

(Proprietorship or Partnership)

Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(CORPORATE SEAL)

The State of North Carolina through

Witness:

(Agency, Department or Institution)

By: _____

Title: _____

FORM OF PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____
Name of Principal
(Contractor) _____

Name of Surety: _____

Name of Contracting
Body: _____

Amount of Bond: _____

Project _____

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind, ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body, identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the contracting body, with or without notice to the surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness: _____

Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice
Pres. only)

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(Corporate Seal)

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

(Surety Corporate Seal)

FORM OF PAYMENT BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal
(Contractor) _____

Name of Surety: _____

Name of Contracting
Body: _____

Amount of Bond: _____

Project _____

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall promptly make payment to all persons supplying labor/material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec.. only)

(Corporate Seal)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

Contractor: (Trade or Corporate Name)

By: _____

Title _____
(Owner, Partner, or Corp. Pres. or Vice
Pres. only)

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

(Surety Corporate Seal)

Sheet for Attaching Power of Attorney

Sheet for Attaching Insurance Certificates

APPROVAL OF THE ATTORNEY GENERAL

DRAFT

**CERTIFICATION BY THE OFFICE OF STATE
BUDGET AND MANAGEMENT**

Provision for the payment of money to fall due and payable by the

under this agreement has been provided for by allocation made and is available for the purpose of carrying out this agreement.

This _____ day of _____ 20____.

Signed _____
Budget Officer

Identification of HUB Certified/ Minority Business Participation

I, _____
(Name of Bidder)

do hereby certify that on this project, we will use the following HUB Certified/ minority business as construction subcontractors, vendors, suppliers or providers of professional services.

[illegible]

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

The total value of minority business contracting will be (\$)_____.

State of North Carolina AFFIDAVIT A – Listing of Good Faith Efforts

County of _____

(Name of Bidder)

Affidavit of _____

I have made a good faith effort to comply under the following areas checked:

Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive. (1 NC Administrative Code 30 I.0101)

- ☐ **1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- ☐ **2 --(10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- ☐ **3 – (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ☐ **4 – (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ☐ **5 – (10 pts)** Attended prebid meetings scheduled by the public owner.
- ☐ **6 – (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ☐ **7 – (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- ☐ **8 – (25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ☐ **9 – (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ☐ **10 - (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

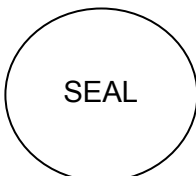
The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

**State of North Carolina --AFFIDAVIT B-- Intent to Perform Contract
with Own Workforce.**

County of _____

Affidavit of _____

(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the _____

_____ contract.

(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

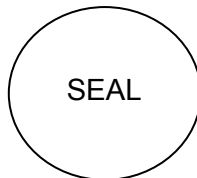
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

State of North Carolina - AFFIDAVIT C - Portion of the Work to be Performed by HUB Certified/Minority Businesses

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by HUB certified/minority businesses as defined in GS143-128.2(g) and 128.4(a),(b),(e) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit.

This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.

Affidavit of _____ I do hereby certify that on the _____
(Name of Bidder)

(Project Name)
Project ID# _____ Amount of Bid \$ _____

I will expend a minimum of _____ % of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.

Attach additional sheets if required

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

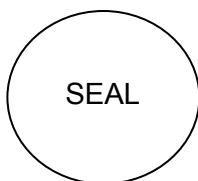
*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____



Signature: _____

Title: _____

State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

State of North Carolina AFFIDAVIT D – Good Faith Efforts

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 10% participation by HUB Certified/ minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

Affidavit of _____ I do hereby certify that on the _____
(Name of Bidder)

Project ID# _____ (Project Name) Amount of Bid \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with HUB certified/ minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. (Attach additional sheets if required)

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Examples of documentation that may be required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

- Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- Copies of quotes or responses received from each firm responding to the solicitation.
- A telephone log of follow-up calls to each firm sent a solicitation.
- For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- Copy of pre-bid roster
- Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- Letter detailing reasons for rejection of minority business due to lack of qualification.
- Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

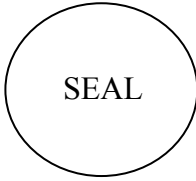
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

APPENDIX E

MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

SCO Project ID: _____

Pay Application #: _____ Period: _____

The following is a list of payments made to Minority Business Enterprises on this project for the above-mentioned period.

MBE FIRM NAME	* TYPE OF MBE	AMOUNT PAID THIS MONTH (With This Pay App)	TOTAL PAYMENTS TO DATE	TOTAL AMOUNT COMMITTED

*Minority categories: Black (B), Hispanic (H), Asian American (AA), American Indian (AI), White Female (WF), Socially and Economically Disadvantaged (SED)

Approved/Certified By:

Name

Title

Date

Signature

SUBMIT WITH EACH PAY REQUEST - FINAL PAYMENT - FINAL REPORT

STATE OF NORTH CAROLINA COUNTY SALES AND USE TAX REPORT SUMMARY TOTALS AND CERTIFICATION

CONTRACTOR: _____ Page 1 of _____

PROJECT: _____ FOR PERIOD: _____

	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL ALL COUNTIES
CONTRACTOR							
SUBCONTRACTOR(S)*							
COUNTY TOTAL							

* Attach subcontractor(s) report(s)
** Must balance with Detail Sheet(s)

I certify that the above figures do not include any tax paid on supplies, tools and equipment which were used to perform this contract and only includes those building materials, supplies, fixtures and equipment which actually became a part of or annexed to the building or structure. I certify that, to the best of my knowledge, the information provided here is true, correct, and complete.

Sworn to and subscribed before me,

This the _____ day of _____, 20____ Signed _____

Notary Public

My Commission Expires: _____ Print or Type Name of Above _____

Seal

NOTE:
This certified statement may be subject to audit.



ECS Southeast, LLP

Geotechnical Engineering Report

UNCW Parking Deck

Wilmington, New Hanover County, North Carolina

ECS Project Number # 22:27313R2

February 5, 2019





ECS SOUTHEAST, LLP

Geotechnical • Construction Materials • Environmental • Facilities

"Setting the Standard for Service"

NC Registered Engineering Firm F-1078
NC Registered Geologists Firm C-406
SC Registered Engineering Firm 3252

February 5, 2019

Mr. Richard Collier
McKim & Creed
243 North Front Street
Wilmington, North Carolina 28401

ECS Project No. 22:27313R2

Reference: Geotechnical Engineering Report
UNCW Parking Deck
Wilmington, New Hanover County, North Carolina

Dear Mr. Collier:

ECS Southeast, LLP (ECS) has completed the subsurface exploration, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our Proposal No. 22:22867, dated November 2, 2018. This report presents our understanding of the geotechnical aspects of the project along, the results of the field exploration conducted, and our design and construction.

It has been our pleasure to be of service to McKim & Creed during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify the assumptions of subsurface conditions made for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Southeast, LLP

Annemarie Crumrine, E.I.
Project Manager
ACrumrine@ecslimited.com

Winslow Goins, PE
Principal Engineer
WGoins@ecslimited.com



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APPENDICES

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EXECUTIVE SUMMARY

The following summarizes the main findings of the exploration, particularly those that may have a cost impact on the planned development. Further, our principal foundation recommendations are summarized. Information gleaned from the executive summary should not be utilized in lieu of reading the entire geotechnical report.

- The geotechnical exploration performed for the planned development included eleven (11) electronic cone penetration test (CPT) soundings drilled to termination and refusal depths ranging from 10 to 70 feet. Two (2) Kessler dynamic cone penetrometer (DCP) tests were performed in the proposed pavement areas.
- On January 31, 2019, three (3) Kessler dynamic cone penetrometer (DCP) tests were performed in the proposed pavement areas in the west lot.
- The soundings generally encountered coastal plain soils consisting of Very Loose to Very Dense, Silty, Clean, and Gravelly SAND (SM, SP, SW) with layers of very soft to very stiff, Sandy and Clayey SILT (ML), and Silty, Lean, and Fat CLAY (CL-ML, CL, CH). Refusal was encountered in sounding S-5 at approximately 70 feet beneath the existing ground surface.
- In summary, the proposed structure can be supported with a shallow foundation with ground improvement consisting of rigid inclusions having an allowable bearing pressure of 6,000 psf or alternatively a deep foundation system consisting of 10" pipe piles, or 16" auger cast in place piles. Specific embedment depths and allowable loads are provided in Section 5.1.1 of the report.

1.0 INTRODUCTION

1.1 GENERAL

The purpose of this study was to provide geotechnical information for the design of a proposed new multi-level parking deck and revisions to the existing parking lot located off of Riegel Road in Wilmington, New Hanover County, North Carolina.

This report contains the results of our subsurface explorations, site characterization, engineering analyses, and recommendations for the design and construction of the proposed structure, drives, and parking lot.

1.2 SCOPE OF SERVICES

To obtain the necessary geotechnical information required for design of the structure nine (9) (CPT) soundings were performed. In the proposed pavement areas, two (2) (CPT) soundings and two (2) Kessler DCP tests were performed during the initial field investigation on November 20, 2018. Three (3) additional Kessler DCP tests were performed on January 31, 2019. The soundings were advanced to termination and refusal depths of approximately 10 to 70 feet beneath the ground surface.

This report discusses our exploratory and testing procedures, presents our findings and evaluations and includes the following.

- A brief review and description of our field test procedures and the results of testing conducted;
- A review of surface topographical features and site conditions;
- A review of area and site geologic conditions;
- A review of subsurface soil stratigraphy with pertinent available physical properties;
- Preliminary foundation recommendations;
 - Allowable bearing pressure;
 - Settlement estimates (total and differential);
- Deep foundation recommendations;
- Site development recommendations;
- Suitability of soils for use as fill material;
- Discussion of groundwater impact;
- Compaction recommendations;
- Pavement design recommendations;
- Special conditions encountered;
- Seismic site classification and liquefaction potential;
- Site vicinity map;
- Exploration location plan; and
- CPT sounding logs.

1.3 AUTHORIZATION

Our services were provided in accordance with our Proposal No. 22.22867, dated November 2, 2018, and Proposal No. 22.23032, dated January 23, 2019, and includes the Terms and Conditions of Service outlined with our Proposal.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION

The proposed site is located off of Riegel Road on UNCW's campus in Wilmington, New Hanover County, North Carolina. The site is bounded on the southwest by Riegel Road, on the south by an existing building, and on the northwest by existing parking lot, and on the north and east by wooded areas. Figure 2.1.1 below shows an image of where the site is located.

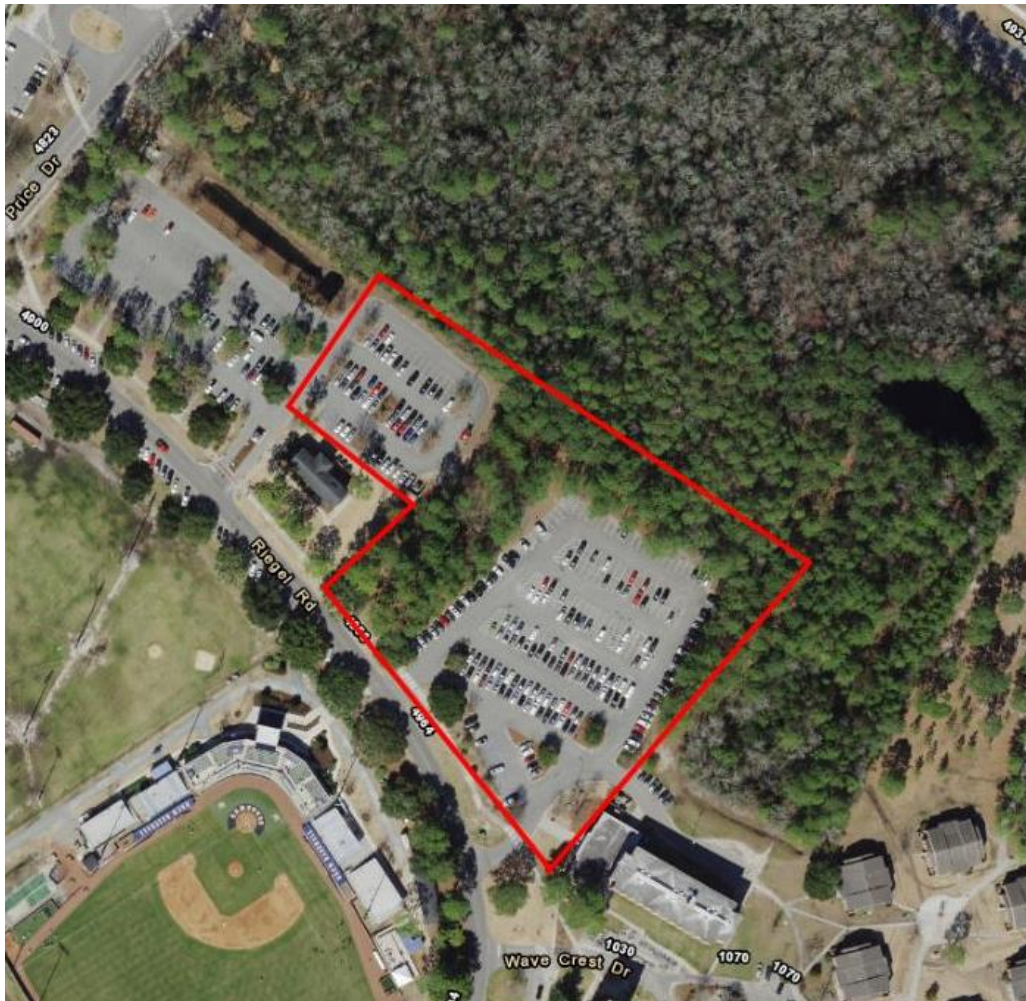


Figure 2.1.1 Site Location

2.2 CURRENT SITE CONDITIONS

The site currently consists of an existing paved parking lot "L" with moderately wooded areas around the parking lot. Based on our site visit and approximate elevations taken from Google Earth, the site appears to slightly slope up towards the northwest side of the site with typical elevations on site ranging from around 38 to 46 feet.

2.3 PROPOSED CONSTRUCTION

ECS understands that the project consists of construction of a new four-level or five-level parking deck with approximately 780 to 1,000 parking spaces. The project also includes revisions to the existing parking lot "L" consisting of 98 surface parking spaces.

2.3.1 Site Civil Features

- Grading for drives, parking area and the building pad
- Cuts and fills less than 5 feet

2.3.2 Structural Information/Loads

At the time of this report, additional project information including structural loads and grading information was not available. The following information explains our assumed structural loads for the purpose of the recommendations made in this report:

Table 2.3.2.1 Design Values

SUBJECT	DESIGN INFORMATION / EXPECTATIONS
Usage	Parking Deck
Column Loads	Up to 1,400 kips for interior columns and up to 350 kips for exterior columns
Wall Loads	Up to 40 kips/ft.
Finish Floor Elevation	+/- 5 feet (assumed)

3.0 FIELD EXPLORATION

3.1 FIELD EXPLORATION PROGRAM

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms and to evaluate subsequent field and laboratory data to assist in the determination of geotechnical recommendations.

3.1.1 Cone Penetrometer Soundings

The subsurface conditions were explored by drilling eleven (11) electronic cone penetration test (CPT) soundings within the proposed parking deck and surface lot. The soundings were advanced to termination and refusal depths of 10 to 70 feet.

Sounding locations were located in the field by an ECS representative using a hand held GPS unit and referencing existing site features. The approximate as-drilled sounding locations are shown on the Exploration Location Diagram in Appendix A.

The CPT soundings were conducted in general accordance with ASTM D 5778. The cone used in the soundings has a tip area of 10 cm² and a sleeve area of 150 cm². The CPT soundings recorded tip resistance and sleeve friction measurements to assist in determining pertinent index and engineering properties of the site soils. The ratio of the sleeve friction to tip resistance is then used to aid in assessing the soil types through which the tip is advanced. The results of the CPT soundings are presented in Appendix B.

Within sounding S-5, seismic tests were performed at approximately three foot intervals to termination depth to measure the shear wave velocity (v_s) of the subsurface materials to aid in assessing the dynamic response properties of the site subsurface materials. The seismic shear waves are generated by making impact with a 20-pound sledgehammer onto a steel beam. The impacts are initiated on the right and left sides of the CPT rig and the corresponding wave traces recorded on an oscilloscope are analyzed to determine the shear wave velocity of the tested material. The waves are measured with three geophones that are installed in the cone. The results of the CPT soundings are presented in Appendix B.

3.1.2 Kessler Dynamic Cone Penetrometer Tests

Two (2) Kessler Dynamic Cone Penetrometer (DCP) tests were performed in the location of the drive and parking lot areas during the initial field investigation on November 20, 2018. Three (3) additional Kessler DCP tests were performed on January 31, 2019 in the west lot. The Kessler DCP is used to estimate the strength characteristics of soils. The Kessler DCP was continuously driven approximately 2 feet below the existing ground surface. The Kessler DCP is driven into the soil by dropping a Dual-Mass 17.6 lb Hammer from a height of 22.6 inches. The depth of cone penetration is measured at selected penetration or hammer drop intervals and the soil shear strength is reported in terms of the Kessler DCP index. The Kessler DCP index is based on the average penetration depth resulting from one blow of the 17.6 lb hammer. The Kessler DCP index can be correlated to CBR and modulus of rigidity. The individual results of the Kessler DCP tests are presented in Appendix B.

3.2 REGIONAL/SITE GEOLOGY

The site is located in the Coastal Plain Physiographic Province of North Carolina. The Coastal Plain is composed of seven terraces, each representing a former level of the Atlantic Ocean. Soils in this area generally consist of sedimentary materials transported from other areas by the ocean or rivers. These deposits vary in thickness from a thin veneer along the western edge of the region to more than 10,000 feet near the coast. The sedimentary deposits of the Coastal Plain rest upon consolidated rocks similar to those underlying the Piedmont and Mountain Physiographic Provinces. In general, shallow unconfined groundwater movement within the overlying soils is largely controlled by topographic gradients. Recharge occurs primarily by infiltration along higher elevations and typically discharges into streams or other surface water bodies. The elevation of the shallow water table is transient and can vary greatly with seasonal fluctuations in precipitation.

Based on the U.S. Geological Survey^{1,2} the site of the proposed construction is underlain by the Castle Hayne Formation (Tec). The formation generally consists of bluish gray to tan, loosely consolidate fossiliferous sand with silt and clay underlain by limestone. The coastal plain soils generally consist of silty, clean, and gravelly sands, silts, and silty, lean, and fat clays. An overview of the general site geology is illustrated in Figure 3.2.1 below.

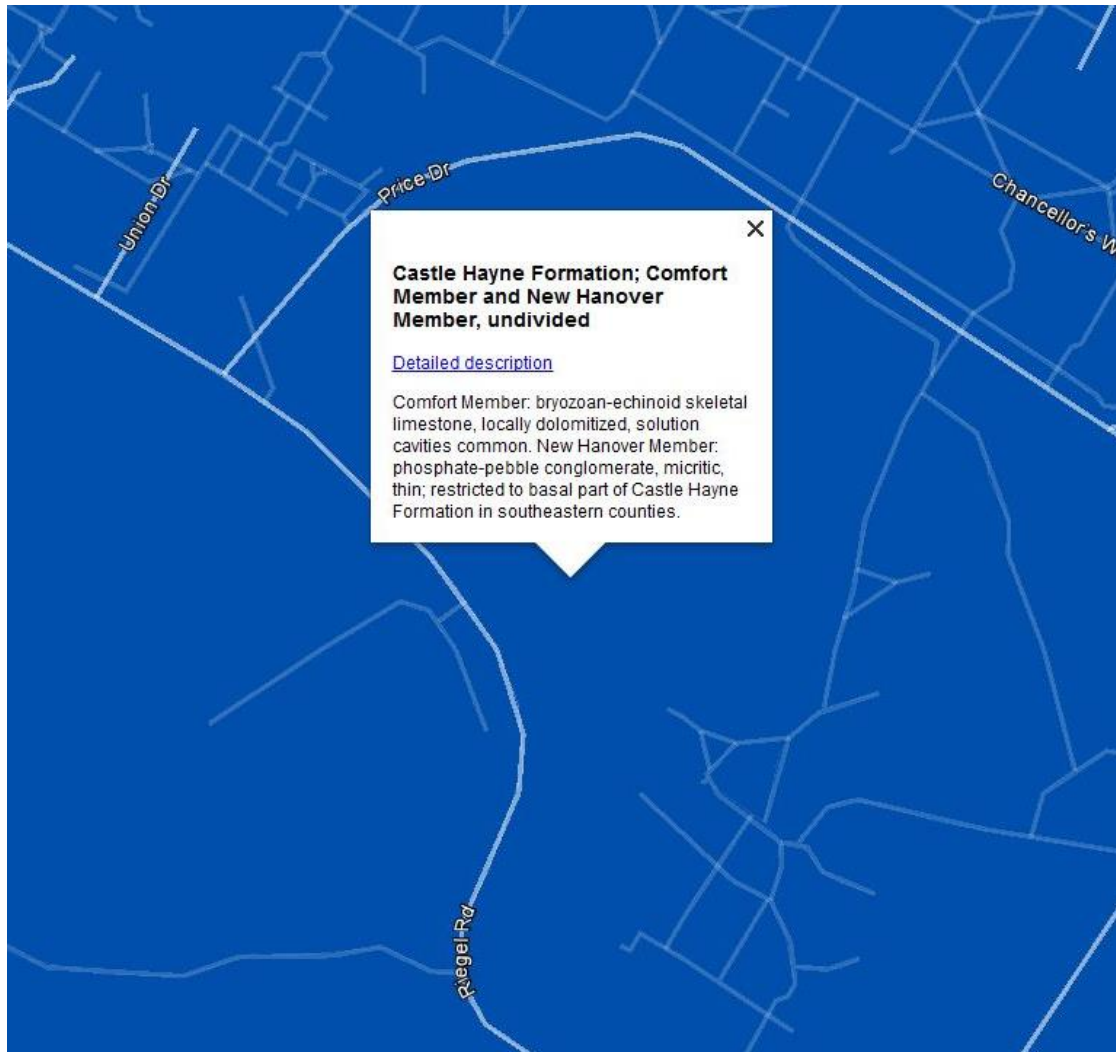


Figure 3.2.1

Geologic map for Figure 3.2.1 obtained from The North Carolina Dept. of Environment, Health, and Natural Resources, Division of Land Resources, NC Geological Survey, in cooperation with the NC Center for Geographic Information and Analysis, 1998, Geology - North Carolina (1:250,000), coverage data file geol250 and Google Earth.

¹ The North Carolina Dept. of Environment, Health, and Natural Resources, Division of Land Resources, NC Geological Survey, in cooperation with the NC Center for Geographic Information and Analysis, 1998, Geology - North Carolina (1:250,000), coverage data file geol250. The data represents the digital equivalent of the official State Geology map (1:500,000 scale), but was digitized from (1:250,000 scale) base maps.

² Rhodes, Thomas S., and Conrad, Stephen G., 1985, Geologic Map of North Carolina: Department of Natural Resources and Community Development, Division of Land Resources, and the NC Geological Survey, 1:500,000-scale, compiled by Brown, Philip M., et al, and Parker, John M. III, and in association with the State Geologic Map Advisory Committee.

3.3 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil encountered during our subsurface exploration. For subsurface information at a specific location, refer to the CPT Sounding Logs in Appendix B.

Table 3.3.1 Subsurface Stratigraphy

Approximate Depth Range	Stratum	Description	Ranges of N*-Values(1) blows per foot (bpf)
0 to 0.25 (Surface cover)	N/A	Soundings/Borings contained an observed thickness of minimal amounts to 3 inches of topsoil. Deeper topsoil or organic laden soils are most likely present in wet, poorly drained areas and potentially unexplored areas of the site. In soundings, S-5 and S-8, approximately 4 inches of asphalt underlain by 5 inches of aggregate base was encountered.	N/A
(0-0.25) to 8	I	Very Loose to Dense, Silty, Clean, and Gravelly SAND (SM, SP, SW) with occasional interbedded layers of very soft to firm, Sandy SILT (ML). Possible Fill SAND (SP) was encountered in some of the soundings in the upper 2 to 4 feet.	2 to 34
8 to 15	II	Very Loose to Dense, Silty, and Clean SAND (SM, SP) with interbedded layers of very soft to very stiff, Sandy and Clayey SILT (ML) and Silty and Lean CLAY (CL-ML, CL)	2 to 44
15 to 26	III	Loose to Very Dense, Silty, Clean, and Cemented SAND (SM, SP) with interbedded layers of soft to very stiff, Sandy and Clayey SILT (ML) and Silty and Lean CLAY (CL-ML, CL)	3 to 52
26 to 30	IV	Medium Dense to Very Dense, Silty, Clean, and Cemented SAND (SM, SP)	16 to 52
30 to 60		Medium Dense, Silty and Clean SAND (SM, SP) with occasional interbedded layers of stiff to very stiff, Sandy SILT (ML)	13 to 27
60 to 70	IV	Soft to Stiff, Sandy and Clayey SILT (ML) and Silty, Lean, and Fat CLAY (CL-ML, CL, CH) with interbedded layers of loose to medium dense, Silty and Clean SAND (SM, SP). Sounding, S-5 encountered refusal at 70 feet.	4 to 18

Notes: (1) Cone Penetration Test

3.4 GROUNDWATER OBSERVATIONS

Porewater pressure measurements were made at the sounding and boring locations during exploration as noted on the CPT sounding logs and the hand auger boring logs in Appendix B. The apparent groundwater depths were observed at the time of exploration to have approximately ranged from 4.2 to 14.0 feet below ground surface.

The highest groundwater observations are normally encountered in the late winter and early spring. Variations in the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, construction activities, and other factors not immediately apparent at the time of this exploration. If long term water levels are crucial to the development of this site, it would be prudent to verify water levels with the use of perforated pipes or piezometers.

3.5 SEASONAL HIGH WATER TABLE AND INFILTRATION TESTING

The results of the seasonal high water table and infiltration testing are shown in the report included in Appendix D of this report.

4.0 LABORATORY TESTING

The laboratory testing performed by ECS for this project consisted of selected tests performed on samples obtained during our field exploration operations. The following paragraphs briefly discuss the results of the completed laboratory testing program. Classification and index property tests were performed on representative soil samples obtained from the test borings in order to aid in classifying soils according to the Unified Soil Classification System and to quantify and correlate engineering properties.

An experienced geotechnical engineer/engineering geologist visually classified each soil sample from the test borings on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS) and ASTM D-2488 (Description and Identification of Soils-Visual/Manual Procedures). After classification, the geotechnical engineer/engineering geologist grouped the various soil types into the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs are approximate; in situ, the transitions may be gradual.

5.0 DESIGN RECOMMENDATIONS

5.1 BUILDING DESIGN

The following sections provide recommendations for foundation design, soil supported slabs, and pavement design.

5.1 Foundation Options

5.1.1 Intermediate Foundations (Ground Improvement for Shallow Foundations)

A ground improvement system consist of rigid inclusions can be used to transfer the stress of a shallow foundation system to stiffer soils at the site. Rigid inclusion systems general consist of cement treated aggregate, grouted aggregate, or concrete column elements and a load transfer platform below the foundation. The elements installed with a displacement tool mounted on a tracked carrier system. As the tool is advanced to the designed bear stratum elevation, granular soil layers in the upper stratum are densified by the displacement tool. Once the design bearing stratum elevation is encountered by the displacement tool, grout is pumped through the tool out a port at the tip of the tool. The tool is extracted at a designed rate and grout pressure to maintain a positive grout head during extraction. The element is terminated at a design elevation below the foundation elevation. Typically, gravel or stone is placed in the remaining space between the top of the element and the site subgrade to mark the element location to prevent grading contractors or utility contractors from excavating and damaging the elements after installation.

Depending on the soil conditions at the foundation subgrade elevation, a load transfer platform consisting of the existing granular soil or granular fill consisting of sand or gravel will need to be installed after foundation excavation is performed. This may result in additional excavation of the foundations, and the foundation contractor should be aware of this and account for it in the bidding process.

Based on the provided loads for the parking deck, ECS performed a preliminary rigid inclusion analysis for the design of shallow foundation system. The design of the foundation shall utilize the following parameters:

Table 5.1.1.1 Foundation Design

Design Parameter	Column Footing	Wall Footing
Net Allowable Bearing Pressure ¹	6,000 psf	6,000 psf
Acceptable Bearing Soil Material	Medium Dense SAND (SP) - Stratum I	Medium Dense SAND (SP) - Stratum I
Minimum Width	24 inches	16 inches
Estimated Total Settlement	1.5 inches	1.5 inches
Estimated Differential Settlement	Less than 1 inch between columns	Less than 0.5 inches over 50 feet

1. Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation. The frost depth for this region is 6 inches.
2. For short-term loading conditions, the allowable bearing pressure can be increase by 1/3.
3. The coefficient of friction for the foundation is 0.40

Detailed design of the rigid inclusion ground improvement program is performed by a design/build specialty geotechnical contractor because of the proprietary nature of the various methods used to construct them. The various methods result in different diameters, depths, and capacity for the elements.

Specifications for rigid inclusion foundation systems should be prepared by the design-build foundation contractor. The specifications should include a provision for at least one load test of a completed element to confirm that the installation can produce elements with a capacity equal to or greater than that used for design.

Rigid inclusion elements should be installed after the site is filled to final grade. Care should be taken to minimize vibrations when installing rigid inclusions near existing structures.

We recommend that ECS be retained to monitor the rigid inclusions installer's operations as a Quality Assurance service. ECS' services will supplement the installer's internal Quality Control program. Together, the QA and QC programs will monitor installation depths, element lengths, installation procedures, concrete/grout properties and cylinder breaks. These items will be documented for each element installed, to provide a complete installation report.

5.1.2 Deep Foundations

Driven Steel Pipe Piles: Steel Pipe Piles can be used to support the proposed parking deck structure. The allowable pile capacities (based on a factor of safety of 2.0 for axial capacity, 3.0 for uplift capacity and ½ inch lateral deflection for lateral capacity) are presented in the following table:

Table 5.1.2.1 10-Inch Driven Steel Pipe Pile with Square Plate at bottom

Embedment Depth (Feet)	Axial Capacity (Tons)	Uplift (Tons)	Lateral (Tons)
70 feet	90	11	6

If shallow refusal is encountered due to dense sand layers, the allowable axial and uplift capacities listed above should be reduced. ECS should be contacted to provide reduced capacities based on the encountered conditions and the PDA analysis performed during the test pile phase.

The loading assumes a free head pile condition with axial and shear forces applied to the pile head. The design capacity of the soils includes the potential negative friction forces for the clay layers in the soil profile and settlement associated with liquefaction.

It is highly recommended that several over length piles be driven prior to the start of production pile driving, to establish the driving criteria, pile lengths to be ordered and to determine if auger "pilot" holes are justified. Depending on the final design load of the pile system selected, a pile load test should be performed for piles with axial load capacities greater than 40 tons in order to verify the pile capacity. The over length piles could be driven in production pile locations. Production piles should not be ordered until the pile lengths can be determined. A minimum of four over length piles, are recommended for this site due to variable soil conditions encountered at the site.

Pile installation operations and PDA testing should be monitored by a senior soil technician working under the supervision of a Licensed Engineer. ECS has the PDA equipment and would be pleased to provide PDA testing once the method of installation and the contractor has been selected. The results of the PDA test are typically submitting three days after the completion of test pile operations.

ECS recommends that the successful bidder submit proposed equipment information including the proposed hammer types and details regarding helmet, cushion, etc. ECS can perform wave equation pile analyses (WEAP) to check the ability of the hammer to drive the pile to the required ultimate resistance, if requested. The WEAP analysis is also a valuable means to check the efficiency of the hammer as well as a means of establishing the driving criteria for production pile installation. The WEAP analysis is also used to check the driving stresses that develop within the piles during driving operations.

Auger Cast-In-Place Piles: Auger Cast-In-Place Piles can support the proposed parking deck structure. The allowable pile capacities (based on a factor of safety of 2.0 for axial capacity, 3.0 for uplift capacity and ½ inch lateral deflection for later capacity) are presented in the following table:

Table 5.1.2.2 16-Inch Auger Cast In Place (ACIP) Pile

Embedment Depth (Feet)	Axial Capacity (Tons)	Uplift (Tons)	Lateral (Tons)
40 feet	36	9	20
70 feet	110	20	20

If shallow refusal is encountered due to dense sand layers, the allowable axial and uplift capacities listed above should be reduced. ECS should be contacted to provide reduced capacities based on the encountered conditions and the pile load test results.

The loading assumes a fixed head pile condition with axial and shear forces applied to the pile head. The design capacity of the soils includes the potential negative friction forces for the clay layers in the soil profile and settlement associated with liquefaction.

The auger withdrawal should be performed in accordance with the North Carolina Building Code (International Building Code 2015 with State Amendments) Section 1810.4.8 to maintain the appropriate grout head for the project. A thorough monitoring of the auger cast pile installation procedures, the grout head, and the grout factor should be implemented. The grout factor is the actual grout volume of the pile divided by the theoretical pile volume. Due to the presence of soft clay and silt layers in some of the soundings, the grout factor could exceed 2 to 3 due to grout expansion into these layers.

We recommend that at least four auger cast test piles be installed in the parking structure to confirm the pile length and to confirm the contractor's installation procedures and techniques.

Depending on the final design load of the pile system selected, a pile load test should be performed for piles with axial load capacities greater than 40 tons in order to verify the pile capacity. Axial compression load tests should be performed in accordance with ASTM D1143. Tension pile load tests should be performed for each structure in accordance with ASTM 3689. The criteria for the pile load test acceptance is the Davisson Offset Limit. The structural engineer of record should determine the number of pile load tests to be performed.

During installation, it is recommended that an approximate 60 inch distance be maintained between adjacent piles. A minimum period of 12 hours is required for installing adjacent piles at less than this minimum distance.

The minimum grout strength for the auger cast in place piles should conform to the NC Building Code Section 1810.3.2.6.

5.1.3 Floor Slabs

Assuming the lowest finished floor elevation is around current elevations, it appears that the slabs for the structures will bear on the Stratum I soils – SAND or Approved Structural Fill. Provided the subgrade recommendations of this report are followed, this material is likely suitable for the support of a slab-on-grade. The following graphic depicts our soil-supported slab recommendations:

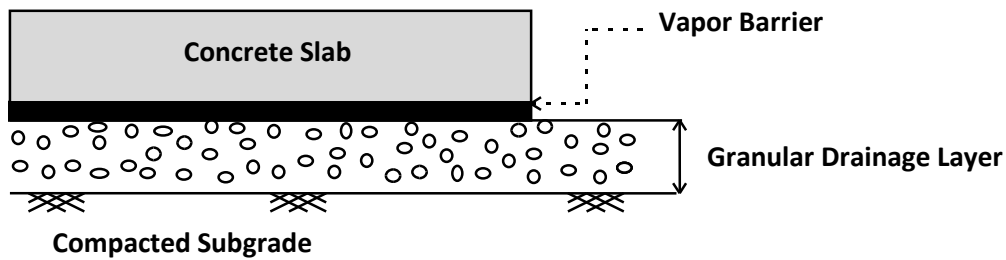


Figure 5.1.2.1

1. Grain Drainage Layer Thickness: 4 inches
2. Grain Drainage Layer Material: GRAVEL (GP, GW, GP-SM, GW-SM), SAND (SP, SW, SP-SM, SW-SM). Material should have less than 20 percent fines, and can consist of No. 57 stone, No. 67 stone, ABC, or screenings (ACI 302.1R-15). Gravel or stone should be wrapped with non-woven geotextile (Mirafi 140N or equivalent).
3. Subgrade compacted to 98% maximum dry density per ASTM D698.

Subgrade Modulus: Provided the placement of structural fill and granular drainage layer per the recommendations discussed herein, the slab may be designed assuming a modulus of subgrade reaction, k of 150 pci (lbs/cu. inch). The modulus of subgrade reaction value is based on a 1 ft by 1 ft plate load test basis.

Slab Isolation: Ground-supported slabs should be isolated from the foundations and foundation-supported elements of the structures so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration prevents the use of a free-floating slab, the slab should be designed with suitable reinforcement and load transfer devices to preclude overstressing of the slab. Maximum differential settlement of soils supporting interior slabs is anticipated to be less than 0.5 inches in 50 feet.

5.1.4 Site Retaining Walls

Site retaining walls are often constructed from the "bottom-up" and therefore the type of soil used to backfill the wall is chosen or specified by contract. The lateral earth pressures developed behind site retaining walls is a function of the backfill soil type within an approximate 45-degree angle from the base of the wall upward.

Lateral Earth Pressures: Retaining walls should be designed to withstand the lateral earth pressures exerted by the backfill. The pressure diagram is triangular. It is anticipated that retaining walls associated with the building structure, such as for the unloading/loading dock situation, will be rigid walls restrained from rotation by the floor slab. For rigid walls, the "At Rest" (k_0) soil condition should be used in the wall design and evaluation. For walls that are free to deflect at their tops, the "Active" (k_a) soil condition should be used in the wall design and evaluation. In the design of these retaining wall structures, the following soil parameters can be utilized. These parameters assume that Granular Soils meeting the requirements recommended herein for Retaining Wall Backfill will comprise the backfill in the Critical Zone. The Critical Zone is defined as the area between the back of the retaining wall structure and an imaginary line projected upward and rearward from the bottom back edge of the wall footing at a 45-degree angle.

Table 5.1.4.1 Retaining Wall Backfill in the Critical Zone

Soil Parameter	Estimated value
Coefficient of Earth Pressure at Rest (K_o)	0.47
Coefficient of Active Earth Pressure (K_a)	0.31
Retained Soil Moist Unit Weight (γ)	125 pcf
Cohesion (C)	0 psf
Angle of Internal Friction (ϕ)	32°
Friction Coefficient [Concrete on Soil] (μ)	0.40
At-rest Equivalent Fluid Pressure	59H (psf)
Active Equivalent Fluid Pressure	39H (psf)

Table 5.1.4.2 Foundation Soils (Natural Subgrades or On-Site Borrow)

Soil Parameter	Estimated value
Allowable Net Soil Bearing Pressure	3,000 psf(natural subgrade) 6,000 psf (ground improvement)
Minimum Wall Embedment Below Grade	18 inches
Coefficient of Passive Earth Pressure (K_p)	3.25
Soil Moist Unit Weight (γ)	120 pcf
Cohesion (C)	0
Interface Friction Angle [Concrete on Soil] (ϕ_i)	20°
Sliding Friction Coefficient [Concrete on Soil] (μ)	0.40
Passive equivalent fluid pressure	390H (psf)

Retaining Wall Backfill: All soils used as backfill within the Critical Zone behind retaining walls should have USCS classifications of Silty SAND (SM) or more granular with a maximum of 20% fines (i.e., % passing No. 200 Sieve size) and minimum angle of internal friction of 32 degrees when compacted to a minimum of 98% of its maximum dry density per ASTM D 698. Any existing soils not meeting these criteria should be removed from the Critical Zone of the walls, as determined by ECS personnel at the time of construction.

Foundation Drains: Retaining walls should be provided with a foundation drainage system to relieve hydrostatic pressures which may develop in the wall backfill. This system should consist of weepholes through the wall and/or a 4-inch perforated, closed joint drain line located along the backside of the walls above the top of the footing. The drain line should be surrounded by a minimum of 6 inches of AASHTO Size No. 57 Stone wrapped with an approved non-woven filter fabric, such as Mirafi 140-N or equivalent.

Wall Drains: All site retaining walls should be drained so that hydrostatic pressures do not build up behind the walls. Wall drains can consist of a 12-inch wide zone of free draining Gravel, such as AASHTO No. 57 Stone, employed directly behind the wall and separated from the soils beyond with a non-woven filter fabric. Alternatively, the wall drain can consist of a suitable geocomposite drainage board material. The wall drain should be hydraulically connected to the foundation drain.

5.1.5 Underslab Subdrainage

ECS doesn't anticipate the need for foundation drainage or underslab subdrainage unless site elevations are lowered to point that the FFE of the slab is within two feet of the groundwater elevation (Four feet below the current elevation of soundings S-3 and S-6). If required, the system may consist of a perimeter foundation drain located one foot below footing subgrade and one foot outside the footing perimeter. The foundation drains should have a minimum diameter of 8 inches, and they should be slotted or appropriately perforated. For the filter fabric we recommend a non-woven product such as Mirafi 140N with an AOS of 70 (U.S. Sieve). An equivalent geotextile fabric can also be used if approved by the Geotechnical Engineer of Record.

A network of a few interior drain lines is needed in addition to the interior perimeter lines due to the size of the footprint. Lateral drain lines under the floor slab should be placed at no more than 60 feet on center or as designed by the GER. Underslab drain lines should have a minimum diameter of 4 inches, and they should be slotted or appropriately perforated. For the filter fabric we recommend a non-woven product such as Mirafi 140N with an AOS of 70 (U.S. Sieve). An equivalent geotextile fabric can also be used if approved by the Geotechnical Engineer of Record. Clean out access should be installed at all sharp bends and at approximately every 100 feet for straight runs.

The exterior and interior drains should be designed to flow a collection point that terminates in a storm water box and daylights out into a storm water collection feature such as a ditch or pond.

5.1.6 Seismic Design Considerations

Seismic Site Classification: The International Building Code (IBC) 2015 requires site classification for seismic design based on the upper 100 feet of a soil profile. Three methods are utilized in classifying sites, namely the shear wave velocity (v_s) method; the unconfined compressive strength (s_u) method; and the Standard Penetration Resistance (N-value) method. The first method (shear wave velocity) was used in classifying this site.

The results of the shear wave velocity profiles are contained in Appendix B. The seismic site class definitions for the weighted average of shear wave velocity or SPT N-value in the upper 100 feet of the soil profile are shown in the following table:

Table 5.1.6.1: Seismic Site Classification

Site Class	Soil Profile Name	Shear Wave Velocity, V_s , (ft./s)	N value (bpf)
A	Hard Rock	$V_s > 5,000$ fps	N/A
B	Rock	$2,500 < V_s \leq 5,000$ fps	N/A
C	Very dense soil and soft rock	$1,200 < V_s \leq 2,500$ fps	>50
D	Stiff Soil Profile	$600 \leq V_s \leq 1,200$ fps	15 to 60
E	Soft Soil Profile	$V_s < 600$ fps	<15

The seismic Site Class for the site was determined by calculating a weighted average of the shear velocities of the overburden to the depth of rock/refusal. The CPT test data indicates that the existing natural, overburden soils at the site have shear velocities ranging from approximately 210 ft/sec to 1549 ft/sec. The method for determining the weighted average value is presented in Section 1613.5.5 of the IBC 2009. The weighted average value for the site is 701 ft/sec. Based on the results of the CPT soundings and our evaluation of the site, the site shall be assigned a seismic class "D".

Liquefaction: The potential for liquefaction at the site is considered low based upon the CPT results and the liquefaction index procedure developed by Iwasaki (1982). Based on our CPT results and our evaluation using a site peak ground acceleration of 0.17, an earthquake event with a magnitude of 7.3 and procedures developed by Robertson (2009) and Boulanger & Idriss (2014), the liquefaction induced settlement at the subject site is estimated to be approximately 2 inches or less.

Ground Motion Parameters: In addition to the seismic site classification noted above, ECS has determined the design spectral response acceleration parameters following the IBC 2009 methodology. The Mapped Responses were estimated from the free [Java Ground Motion Parameter Calculator](#) available from the USGS website. The design responses for the short (0.2 sec, S_{DS}) and 1-second period (S_{D1}) are noted in bold at the far right end of the following table.

Table 5.1.6.2: Ground Motion Parameters (IBC 2015 Method)

Period (sec)	Mapped Spectral Response Accelerations (g)		Values of Site Coefficient for Site Class		Maximum Spectral Response Acceleration Adjusted for Site Class (g)		Design Spectral Response Acceleration (g)	
Reference	Figures 1613.3.1 (1) & (2)		Tables 1613.3.3 (1) & (2)		Eqs. 16-37 & 16-38		Eqs. 16-39 & 16-40	
0.2	S_s	0.216	F_a	1.600	$S_{MS}=F_a S_s$	0.345	$S_{DS}=2/3 S_{MS}$	0.230
1.0	S_1	0.091	F_v	2.400	$S_{M1}=F_v S_1$	0.218	$S_{D1}=2/3 S_{M1}$	0.145

The Site Class definition should not be confused with the Seismic Design Category designation, which the Structural Engineer typically assesses.

5.2 SITE DESIGN CONSIDERATIONS

5.2.1 Pavement Sections

Subgrade Characteristics: Based on the results of our hand auger borings, it appears that the soils that will be exposed as pavement subgrades consisting of SAND (SM, SP) or Approved Structural Fill. Based on the soil type and the Kessler DCP results, a CBR value of 10 has been selected to model the in place subgrade soils. The pavement design assumes subgrades consist of suitable materials evaluated by ECS and placed and compacted to at least 98 percent of the maximum dry density as determined by the standard Proctor test (ASTM D 698) in accordance with the project specifications.

Design Considerations: For the design and construction of exterior pavements, the subgrades should be prepared in strict accordance with the recommendations in the “Subgrade Preparation” and “Engineered Fill Placement” sections of this report. An important consideration with the design and construction of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should minimize the possibility of the subgrade materials becoming saturated during the normal service period of the pavement. The soundings performed in the existing parking lot encountered approximately 4 inches of asphalt overlying approximately 5 inches of aggregate base.

Anticipated traffic conditions were not provided to ECS. However, based on our experience for light duty traffic for similar projects, a flexible pavement section may consist of at least 2 inches of surface mix asphalt overlying at least 6 inches of grade aggregate base in the parking and roadway areas for personal vehicles. Similarly, a heavy duty, flexible pavement section may consist of at least 2 inches of surface mix asphalt overlying at least 8 inches of graded aggregate base in the roadway areas for delivery trucks and garbage trucks. Alternatively, a section consisting of 1.5 inches of surface mix and 2.5 inches of intermediate mix overlying at least 8 inches of graded aggregate base in the roadway areas can be used where the intermediate is put down for construction traffic and topped with the 1.5 inches of surface mix at the completion of the project. For a rigid pavement section, we recommend 6 inches of 4,000 psi compressive strength concrete overlying at least 4 inches of compacted crushed stone in the roadway areas.

Aggregate base course materials beneath pavements should be compacted to at least 98 percent of their modified Proctor maximum dry density (ASTM D 1557).

Regardless of the section and type of construction utilized, saturation of the subgrade materials and asphalt pavement areas results in a softening of the subgrade material and shortened life span for the pavement. Therefore, we recommend that both the surface and subsurface materials for the pavement be properly graded to enhance surface and subgrade drainage. By quickly removing surface and subsurface water, softening of the subgrade can be reduced and the performance of the parking area can be improved. Site preparation for the parking areas should be similar to that for the building areas including stripping, proofrolling, and the placement of compacted structural fill.

Please note that large, front-loading trash dumpsters frequently impose concentrated front-wheel loads on pavements during loading. This type of loading typically results in rutting of bituminous pavements and ultimately pavement failures and costly repairs. Concrete pavements should be properly jointed and reinforced as needed to help reduce the potential for cracking and to permit proper load transfer.

Weather Restrictions: In this region, asphalt plants may close during the months of December, January, and/or February if particularly cold weather conditions prevail. However, this can change based on year to year temperature fluctuations. Daily temperatures from December to February will often stay below 40°F, limiting the days that asphalt placement can occur.

6.0 SITE CONSTRUCTION RECOMMENDATIONS

6.1 SUBGRADE PREPARATION

6.1.1 Stripping and Grubbing

The subgrade preparation should consist of stripping all vegetation, rootmat, topsoil, existing fill, existing footing and pavement, and any other soft or unsuitable materials from the 10-foot expanded building foot prints and 5-foot expanded pavement limits and to 5 feet beyond the toe of structural fills. ECS should be called on to verify that topsoil and unsuitable surficial materials have been completely removed prior to the placement of Structural Fill or construction of the roadways. Existing ABC stone on the site can be stockpiled for re-use. Existing asphalt ground down to an ABC gradation and used in lifts of 4 inches below the ABC stone at the site.

6.1.2 Proofrolling

After removing all unsuitable surface materials, cutting to the proposed grade, and prior to the placement of any structural fill or other construction materials, the exposed subgrade should be examined by the Geotechnical Engineer or authorized representative. The exposed subgrade should be thoroughly proofrolled with previously approved construction equipment having a minimum axle load of 10 tons (e.g. fully loaded tandem-axle dump truck). The areas subject to proofrolling should be traversed by the equipment in two perpendicular (orthogonal) directions with overlapping passes of the vehicle under the observation of the Geotechnical Engineer or authorized representative. This procedure is intended to assist in identifying any localized yielding materials. In the event that unstable or “pumping” subgrade is identified by the proofrolling, those areas should be marked for repair prior to the placement of any subsequent structural fill or other construction materials. Methods of repair of unstable subgrade, such as undercutting or moisture conditioning, should be discussed with the Geotechnical Engineer to determine the appropriate procedure with regard to the existing conditions causing the instability. Test pits may be excavated to explore the shallow subsurface materials in the area of the instability to help in determined the cause of the observed unstable materials and to assist in the evaluation of the appropriate remedial action to stabilize the subgrade.

6.2 EARTHWORK OPERATIONS

6.2.1 Structural Fill Materials

Product Submittals: Prior to placement of structural fill, representative bulk samples (about 50 pounds) of on-site and off-site borrow should be submitted to ECS for laboratory testing, which will include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications.

Satisfactory Structural Fill Materials: Materials satisfactory for use as structural fill should consist of inorganic soils classified as SM, SC, SW, SP, GW, GP, GM and GC, or a combination of these group symbols, per ASTM D 2487. Natural fine-grained soils classified as clays or silts (CL, ML) should generally not be considered for use as engineered fill, but may be evaluated by the geotechnical engineer to determine their suitability at the contractor's request. The materials should be free of organic matter, debris, and should contain no particle sizes greater than 4 inches in the largest dimension. Open graded materials, such as gravels (GW and GP), which contain void space in their mass should not be used in structural fills unless properly encapsulated with filter fabric. Suitable structural fill material should have the index properties shown in Table 6.2.1.1.

Table 6.2.1.1 Structural Fill Index Properties

Location	LL	PI	Max % Fines Passing # 200 Sieve
Building Areas	35 max	9 max	20
Pavement Areas	35 max	9 max	20

Unsatisfactory Materials: Materials that should not be used as engineered fill include topsoil, organic materials (OH, OL), and high plasticity clays and silts (CH, MH). Such materials removed during grading operations should be either stockpiled for later use in landscape fills, or placed in approved on or off-site disposal areas.

On-Site Borrow Suitability: The on-site near surface SANDS (SM, SP) in the upper 8 feet across the site with fines contents less than 20 percent and free of deleterious material and roots should be suitable for re-use as structural fill.

The soils encountered at depths of 1.5 to 3.0 feet in the hand augers performed on January 31, 2019, had natural moisture contents that ranged from 4.6 to 8.6 percent. Based on the standard proctor test performed on the bulk sample obtained on site at depths of 1 to 3 feet the optimum moisture is 12.8 percent with a maximum dry density of 108.0 pounds per cubic foot. Moisture conditioning by means of adding water to the soil should be anticipated for the soils to achieve the optimum moisture content for fill placement.

6.2.2 Compaction

Structural Fill Compaction: Structural fill within the expanded buildings, pavement, and embankment limits should be placed in maximum 8-inch loose lifts, moisture conditioned as necessary to within -3 and +3 % of the soil's optimum moisture content, and be compacted with suitable equipment to a dry density of at least 98% of the standard Proctor maximum dry density (ASTM D-698). Beyond these areas, compaction of at least 95% should be achieved. ECS should be called on to document that proper fill compaction has been achieved.

Fill Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits of the fill zones for buildings, pavements, and slopes, etc., at the time of fill placement. Grade controls should be maintained throughout the filling operations. All filling operations should be observed on a full-time basis by a qualified representative of the construction testing laboratory to determine that the minimum compaction requirements are being achieved. Field density testing of fills will be performed at the frequencies shown in Table 6.2.2.1, but not less than 1 test per lift.

Table 6.2.2.1 Frequency of Compaction Tests in Fill Areas

Location	Frequency of Tests
Building Areas	1 test per 2,500 sq. ft. per lift
Pavement Areas	1 test per 10,000 sq. ft. per lift
Utility Trenches	1 test per 200 linear ft. per lift

Compaction Equipment: Compaction equipment suitable to the soil type being compacted should be used to compact the subgrades and fill materials. A vibratory steel drum roller should be used for compaction of coarse-grained soils (Sands) as well as for sealing compacted surfaces.

Fill Placement Considerations: Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and all frozen or frost-heaved soils should be removed prior to placement of Structural Fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

At the end of each work day, all fill areas should be graded to facilitate drainage of any precipitation and the surface should be sealed by use of a smooth-drum roller to limit infiltration of surface water. During placement and compaction of new fill at the beginning of each workday, the Contractor may need to scarify existing subgrades to a depth on the order of 4 inches so that a weak plane will not be formed between the new fill and the existing subgrade soils.

Drying and compaction of wet soils is typically difficult during the cold, winter months. Accordingly, earthwork should be performed during the warmer, drier times of the year, if practical. Proper drainage should be maintained during the earthwork phases of construction to prevent ponding of water which has a tendency to degrade subgrade soils.

Where fill materials will be placed to widen existing embankment fills, or placed up against sloping ground, the soil subgrade should be scarified and the new fill benched or keyed into the existing material. Fill material should be placed in horizontal lifts. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 inches to 4 inches may be required to achieve specified degrees of compaction.

We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting fill soils. We do not anticipate significant problems in controlling moisture within the fill during dry weather, but moisture control may be difficult during winter months or extended periods of rain. The control of moisture content of higher plasticity soils is difficult when these soils become wet. Further, such soils are easily degraded by construction traffic when the moisture content is elevated.

6.3 FOUNDATION OBSERVATIONS

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 2 to 3-inch thick "mud mat" of "lean" concrete should be placed on the bearing soils before the placement of reinforcing steel.

Footing Subgrade Observations: The preparation of fill subgrades, as well as proposed building subgrades, should be observed on a full-time basis by ECS personnel. These observations should be performed by an experienced geotechnical engineer or qualified person to ensure that unsuitable materials have been removed and that the prepared subgrade meets project requirements for support of the proposed construction and/or fills.

6.4 UTILITY INSTALLATIONS

Utility Subgrades: Most of the soils encountered in our exploration are expected to be suitable for support of utility pipes. The pipe subgrade should be observed and probed for stability by ECS to evaluate the suitability of the materials encountered. Any loose or unsuitable materials encountered at the utility pipe subgrade elevation should be removed and replaced with suitable compacted Structural Fill or pipe bedding material.

Utility Backfilling: The granular bedding material should be at least 4 inches thick, but not less than that specified by the project drawings and specifications. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for structural fill given in this report. Compacted backfill should be free of topsoil, roots, ice, or any other material designated by ECS as unsuitable. The backfill should be moisture conditioned, placed, and compacted in accordance with the recommendations of this report.

Utility Excavation Dewatering: It is possible that perched water may be encountered by utility excavations which extend below existing grades. It is expected that removal of perched water which seeps into excavations could be accomplished by pumping from sumps excavated in the trench bottom and which are backfilled with DOT Size No. 57 Stone or open graded bedding material. Should water conditions beyond the capability of sump pumping be encountered, the contractor should submit a Dewatering Plan in accordance with project specifications.

6.5 GENERAL CONSTRUCTION CONSIDERATIONS

Moisture Conditioning: During the cooler and wetter periods of the year, delays and additional costs should be anticipated. At these times, reduction of soil moisture may need to be accomplished by mechanical manipulation, in order to lower moisture contents to levels appropriate for compaction. Alternatively, during the drier times of the year, such as the summer months, moisture may need to be added to the soil to provide adequate moisture for successful compaction according to the project requirements.

Subgrade Protection: Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to control and remove surface water from development areas, including structural and pavement areas. It would be advisable to designate a haul road and construction staging area to limit the areas of disturbance and to prevent construction traffic from excessively degrading sensitive subgrade soils and existing pavement areas. Haul roads and construction staging areas could be covered with excess depths of aggregate to protect those subgrades. The aggregate can later be removed and used in pavement areas.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of 1 percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to minimize infiltration of surface water.

Excavation Safety: All excavations and slopes should be made and maintained in accordance with OSHA excavation safety standards. The contractor is solely responsible for designing and constructing stable, temporary excavations and slopes and should shore, slope, or bench the sides of the excavations and slopes as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

Excavation Considerations: Based on the results of the soundings, we expect that the natural Coastal Plain soils encountered on this site can be excavated with conventional earth moving equipment such as loaders, bulldozers, rubber tired backhoes, etc.

The site soils are OSHA Type C soils for the purpose of temporary excavation support. Excavations should be constructed in compliance with current OSHA standards for excavation and trenching safety. Excavations should be observed by a "competent person," as defined by OSHA, who should evaluate the specific soil type and other conditions, which may control the excavation side slopes or the need for shoring or bracing. Regardless, site safety shall be the sole responsibility of the contractor and their subcontractors. Exposed earth slopes shall be protected during periods of inclement weather.

Erosion Control: The surface soils may be erodible. Therefore, the Contractor should provide and maintain good site drainage during earthwork operations to maintain the integrity of the surface soils. All erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

7.0 CLOSING

ECS has prepared this report of findings, evaluations, and recommendations to guide geotechnical-related design and construction aspects of the project.

The description of the proposed project is based on information provided to ECS by Mr. Richard Collier of McKim & Creed. If any of this information is inaccurate, either due to our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted immediately so that we can review the report in light of the changes and provide additional or alternate recommendations as may be required to reflect the proposed construction.

We recommend that ECS be allowed to review the project's plans and specifications pertaining to our work so that we may ascertain consistency of those plans/specifications with the intent of the geotechnical report.

Field observations, monitoring, and quality assurance testing during earthwork and foundation installation are an extension of and integral to the geotechnical design recommendation. We recommend that the owner retain these quality assurance services and that ECS be allowed to continue our involvement throughout these critical phases of construction to provide general consultation as issues arise. ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Drawings & Reports

Site Location Diagram

Exploration Location Diagram

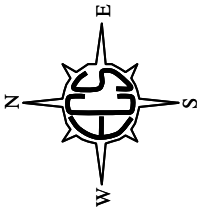


Site Location Diagram **UNCW PARKING DECK**

RIEGEL ROAD, WILMINGTON, NC

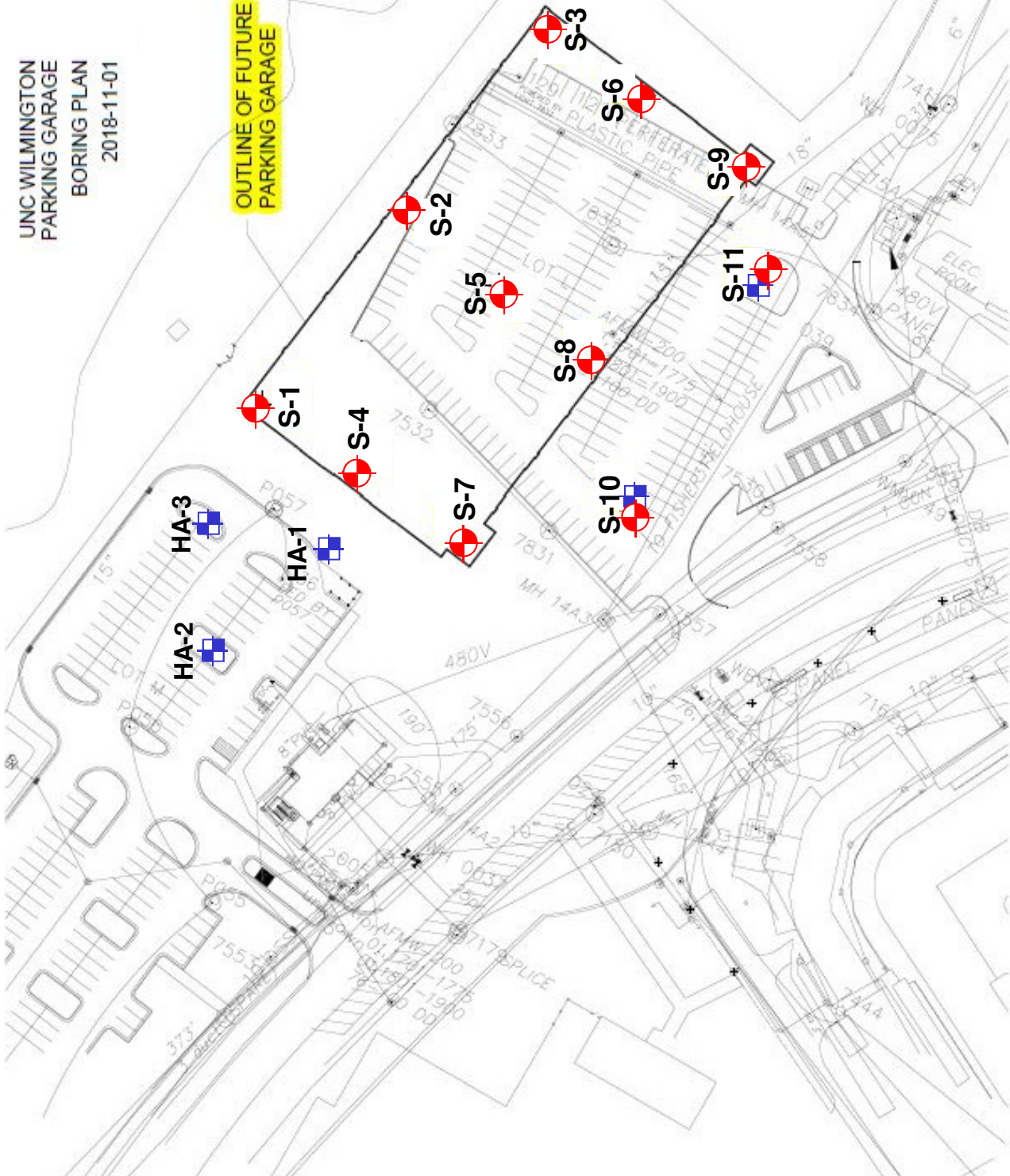
MCKIM & CREED

ENGINEER	WEG
SCALE	1" = 200'
PROJECT NO.	22:27313
SHEET	1 OF 2
DATE	12/11/2018



UNC WILMINGTON
PARKING GARAGE
BORING PLAN
2018-11-01

OUTLINE OF FUTURE
PARKING GARAGE



■ DENOTES APPROXIMATE LOCATION OF HAND
AUGER BORINGS WITH KESSLER DCP

■ DENOTES APPROXIMATE LOCATION OF CPT
SOUNDING



EXPLORATION LOCATION DIAGRAM



UNCW Parking Deck

Wilmington, North Carolina

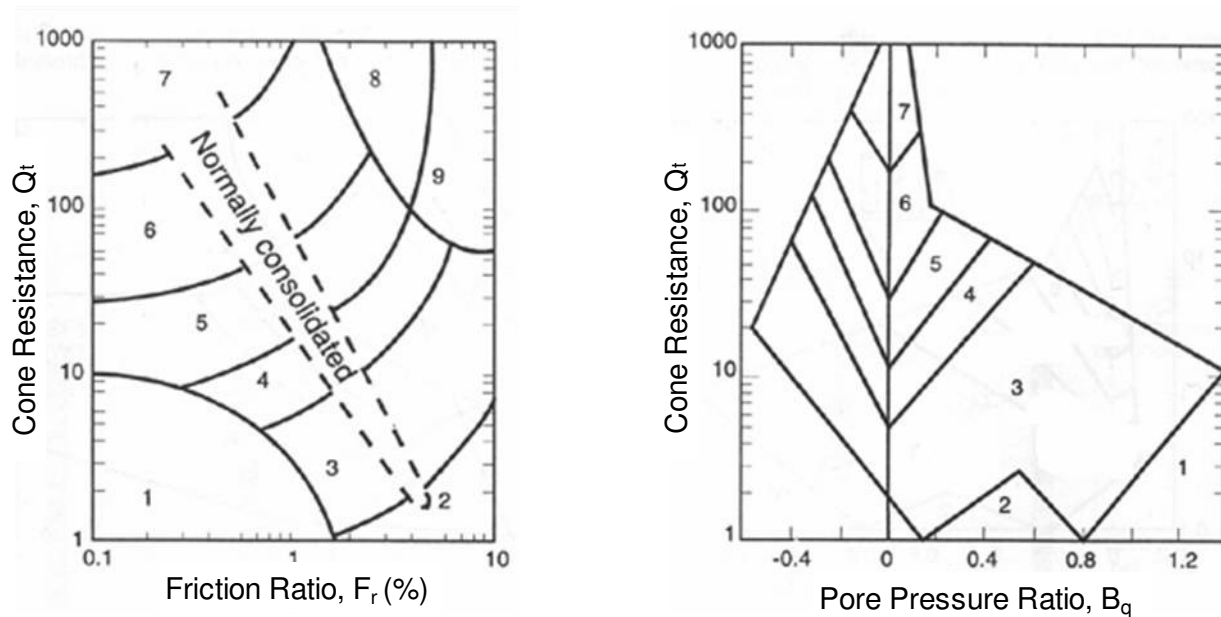
ENGINEER	DRAFTING
WEG	ACC
SCALE	NTS
Project NO.	22-27313R1
SHEET	2 of 2
DATE	2/4/2018

APPENDIX B – Field Operations

Reference Notes for Sounding Logs
CPT Sounding Logs S-1 through S-11
Hand Auger Boring Logs
Kessler DCP Test Results

REFERENCE NOTES FOR CONE PENETRATION TEST (CPT) SOUNDINGS

In the CPT sounding procedure (ASTM-D-5778), an electronically instrumented cone penetrometer is hydraulically advanced through soil to measure point resistance (q_c), pore water pressure (u_2), and sleeve friction (f_s). These values are recorded continuously as the cone is pushed to the desired depth. CPT data is corrected for depth and used to estimate soil classifications and intrinsic soil parameters such as angle of internal friction, preconsolidation pressure, and undrained shear strength. The graphs below represent one of the accepted methods of CPT soil behavior classification (Robertson, 1990).



1. Sensitive, Fine Grained
2. Organic Soils-Peats
3. Clays; Clay to Silty Clay
4. Clayey Silt to Silty Clay
5. Silty Sand to Sandy Silt

6. Clean Sands to Silty Sands
7. Gravelly Sand to Sand
8. Very Stiff Sand to Clayey Sand
9. Very Stiff Fine Grained

The following table presents a correlation of corrected cone tip resistance (q_c) to soil consistency or relative density:

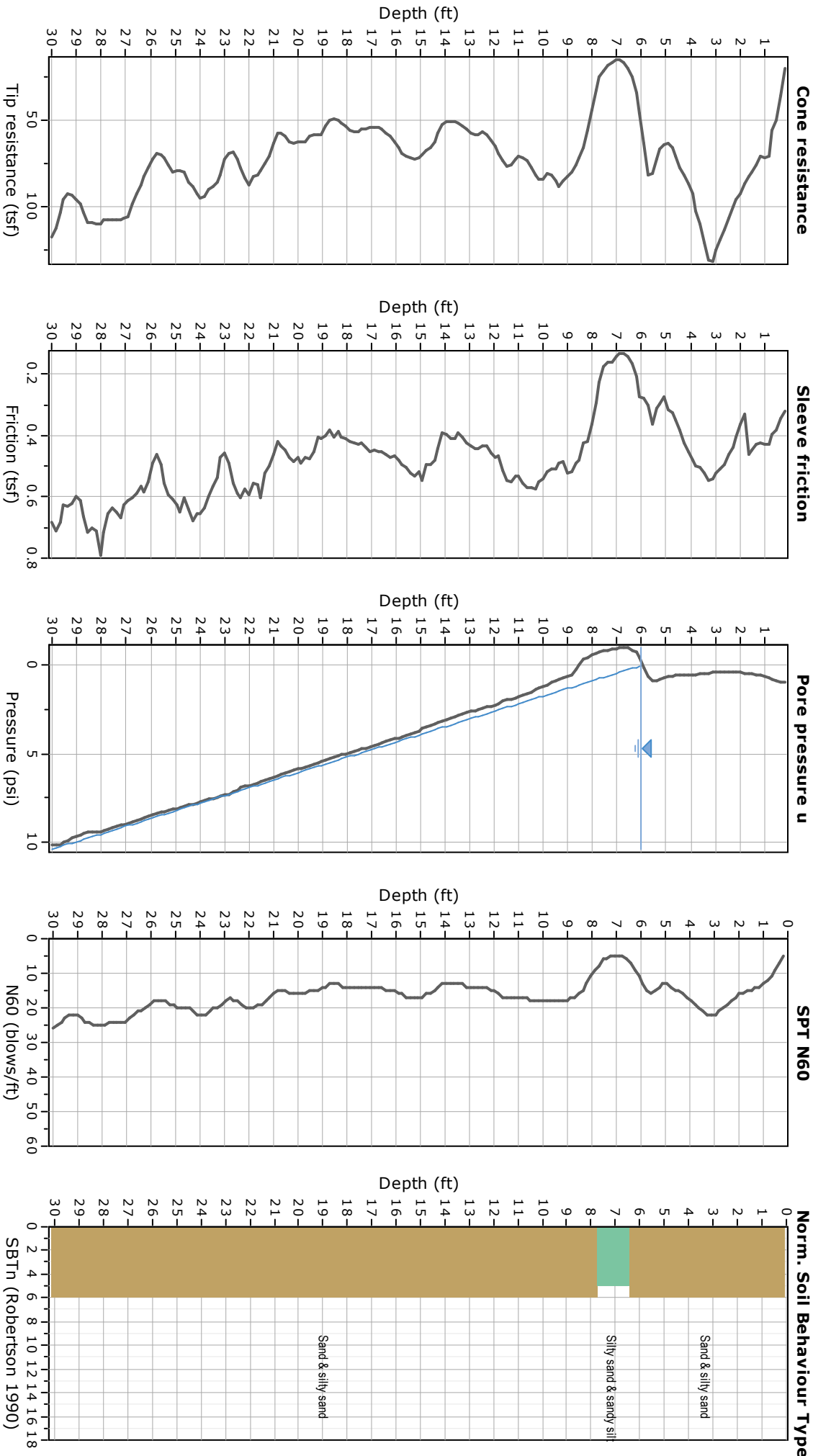
SAND		SILT/CLAY	
Corrected Cone Tip Resistance (q_c) (tsf)	Relative Density	Corrected Cone Tip Resistance (q_c) (tsf)	Relative Density
<20	Very Loose	<5	Very Soft
20-40	Loose	5-10	Soft
40-120	Medium Dense	10-15	Medium Stiff
		15-30	Stiff
120-200	Dense	30-45	Very Stiff
		45-60	Hard
>200	Very Dense	>60	Very Hard

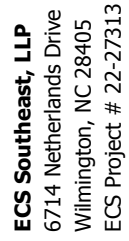


ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405
ECS Project # 22-27313

Project: UNCW Parking Deck
Location: Wilmington, New Hanover County, North Carolina

CPT: S-1
Total depth: 30.02 ft, Date: 11/21/2018
Cone Operator: Cory Robison





CPT: S-2
Total depth: 30.02 ft, Date: 11/21/2018
Cone Operator: Cory Robison



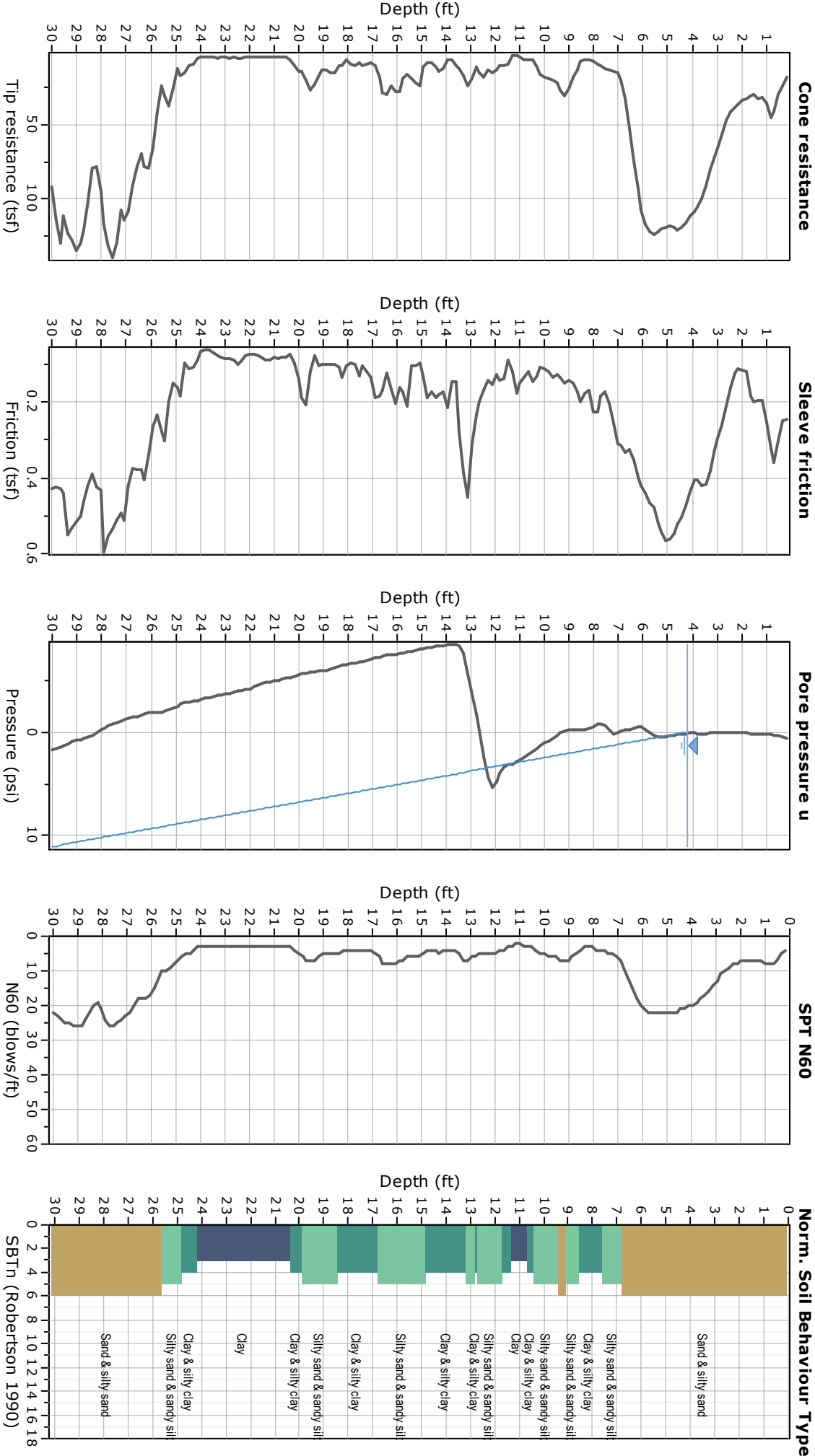


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Project: UNCW Parking Deck
Location: Wilmington, New Hanover County, North Carolina

CPT: S-3

Total depth: 30.02 ft, Date: 11/21/2018
Cone Operator: Cory Robison





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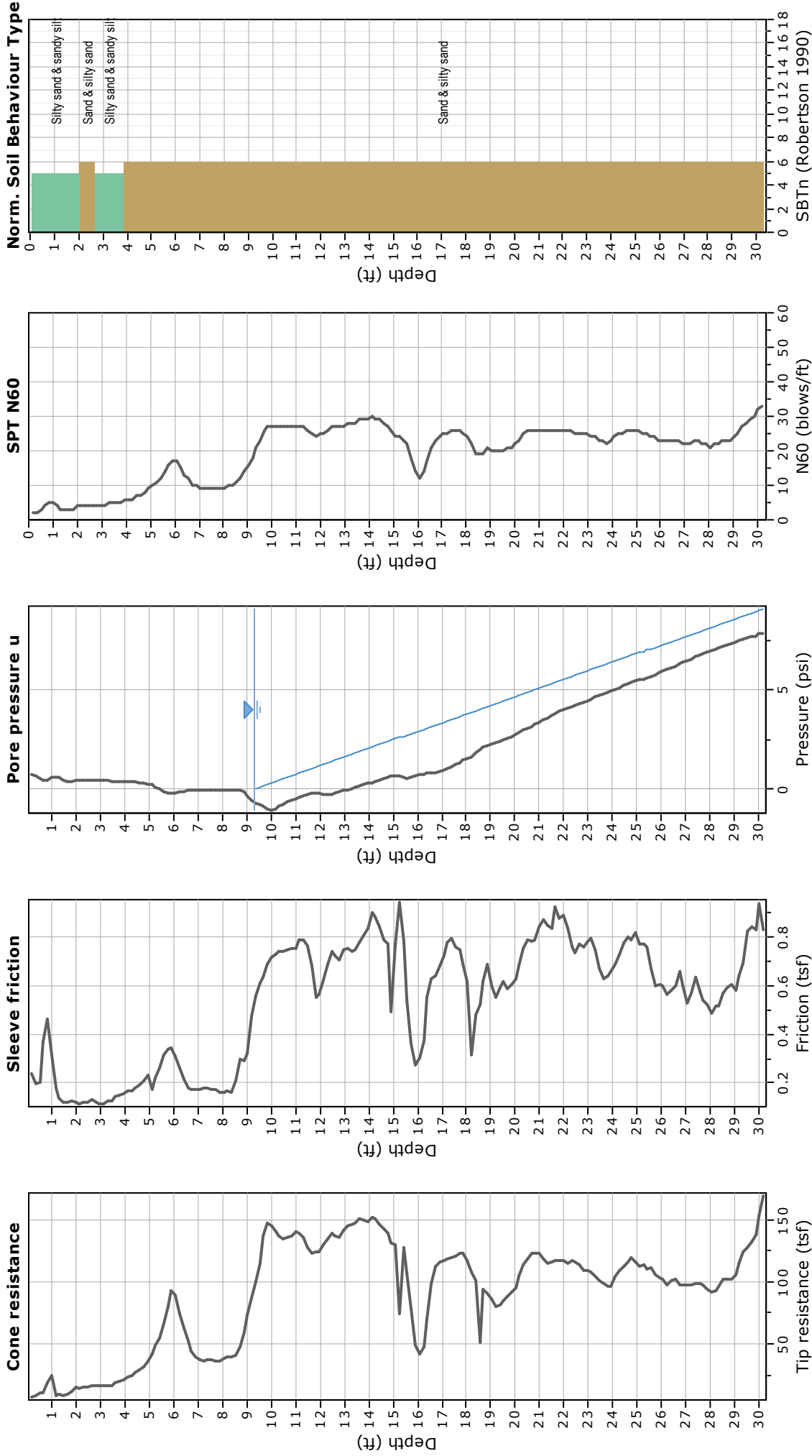
Project: UNCW Parking Deck

Location: Wilmington, New Hanover County, North Carolina

CPT: S-4

Total depth: 30.18 ft, Date: 11/21/2018

Cone Operator: Cory Robison

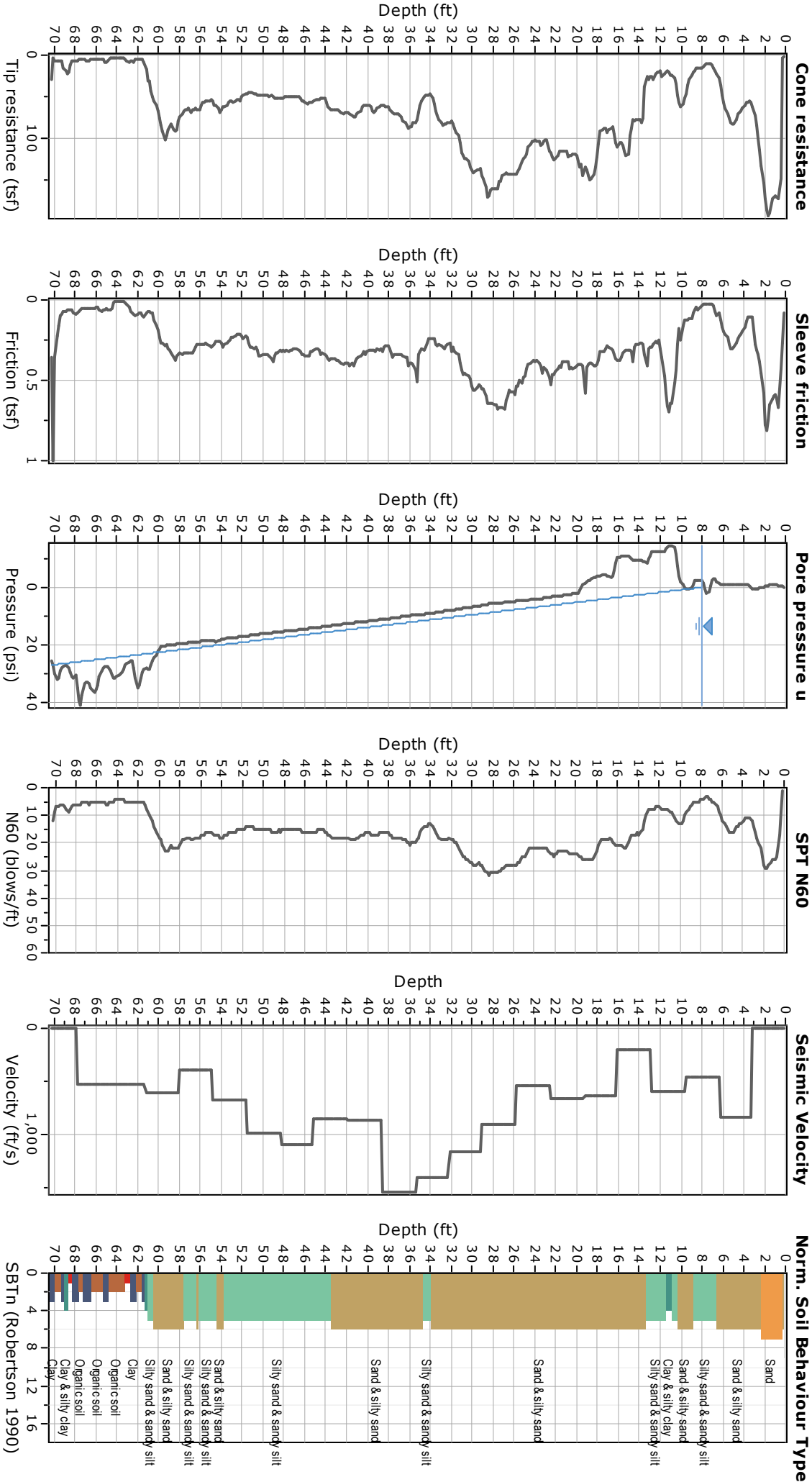




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Project: UNCW Parking Deck
Location: Wilmington, New Hanover County, North Carolina

CPT: S-5
Total depth: 70.21 ft, Date: 11/21/2018
Cone Operator: Austin Fowler





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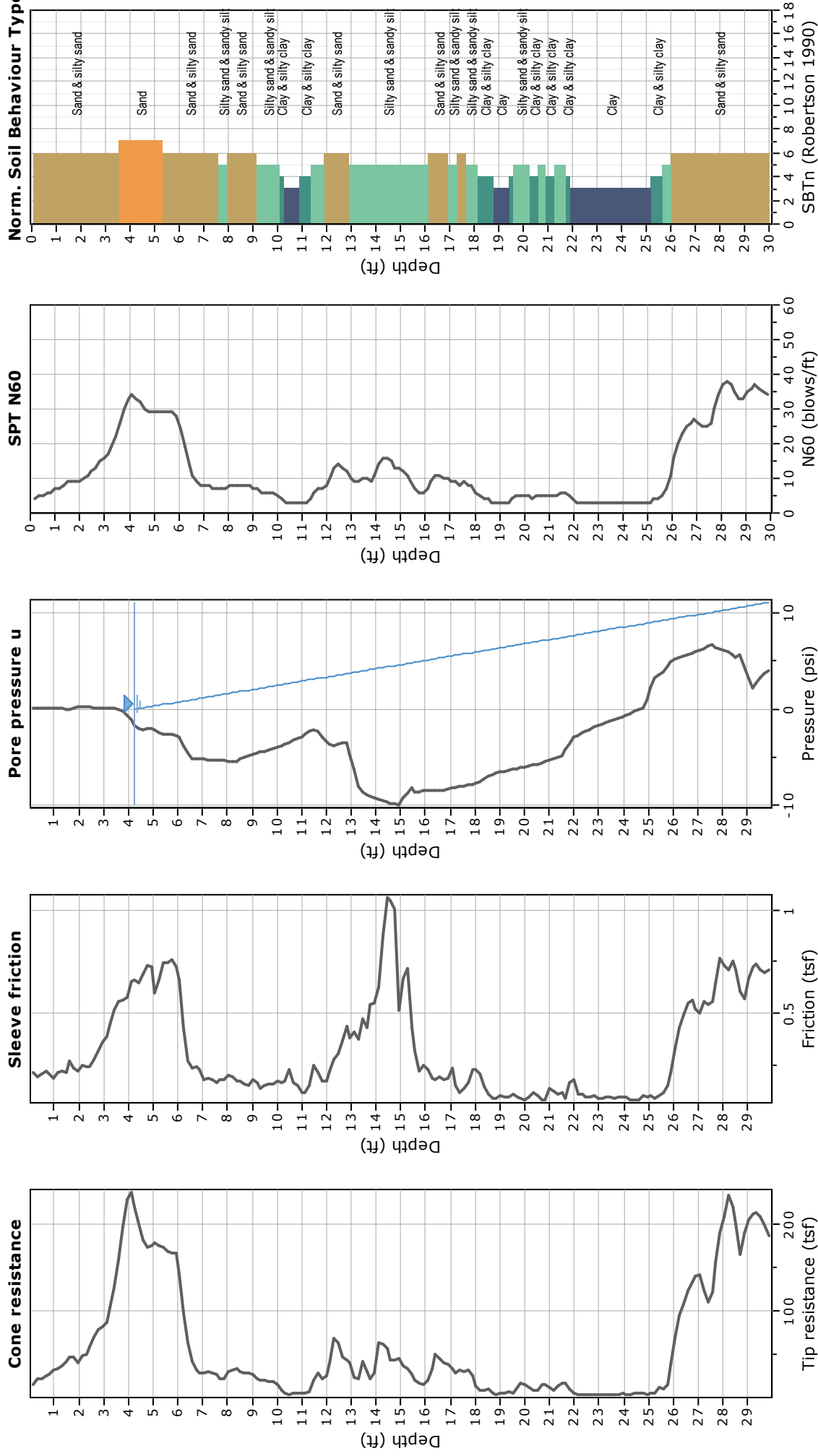
Project: UNCW Parking Deck

Location: Wilmington, New Hanover County, North Carolina

CPT: S-6

Total depth: 29.86 ft, Date: 11/21/2018

Cone Operator: Cory Robison

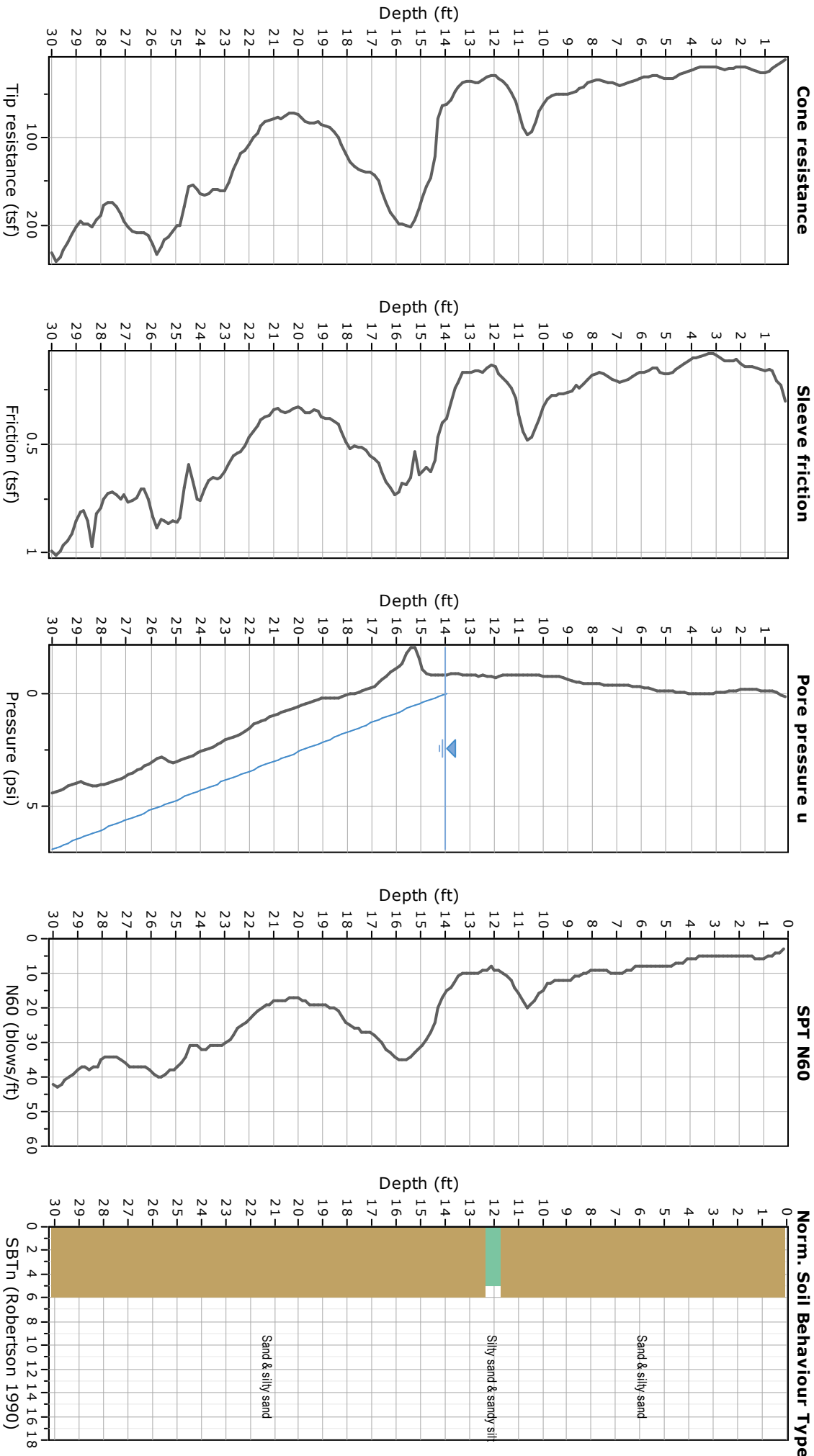




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Project: UNCW Parking Deck
Location: Wilmington, New Hanover County, North Carolina

CPT: S-7
Total depth: 30.02 ft, Date: 11/21/2018
Cone Operator: Cory Robison





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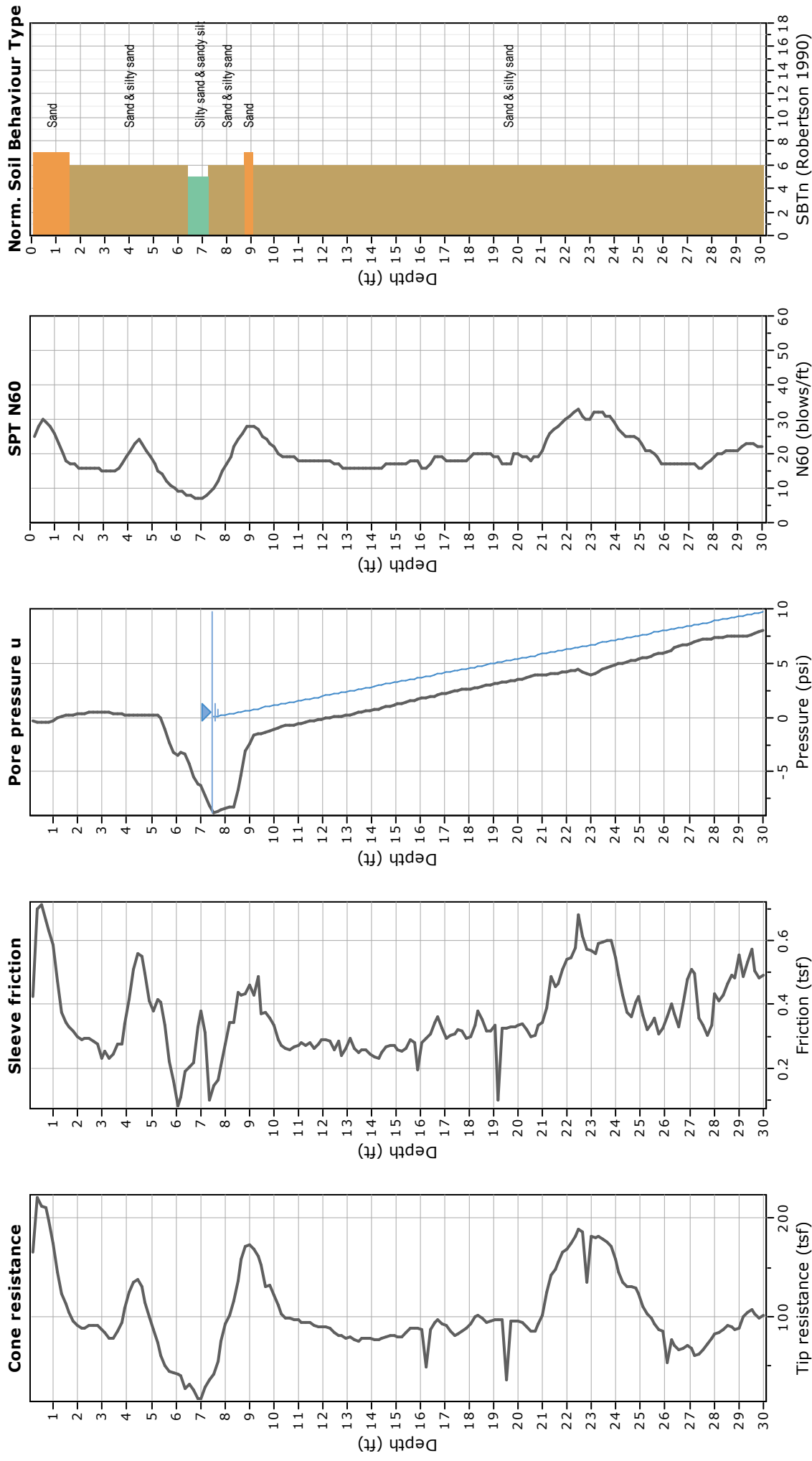
Project: UNCW Parking Deck

Location: Wilmington, New Hanover County, North Carolina

CPT: S-8

Total depth: 30.02 ft, Date: 11/21/2018

Cone Operator: Austin Fowler

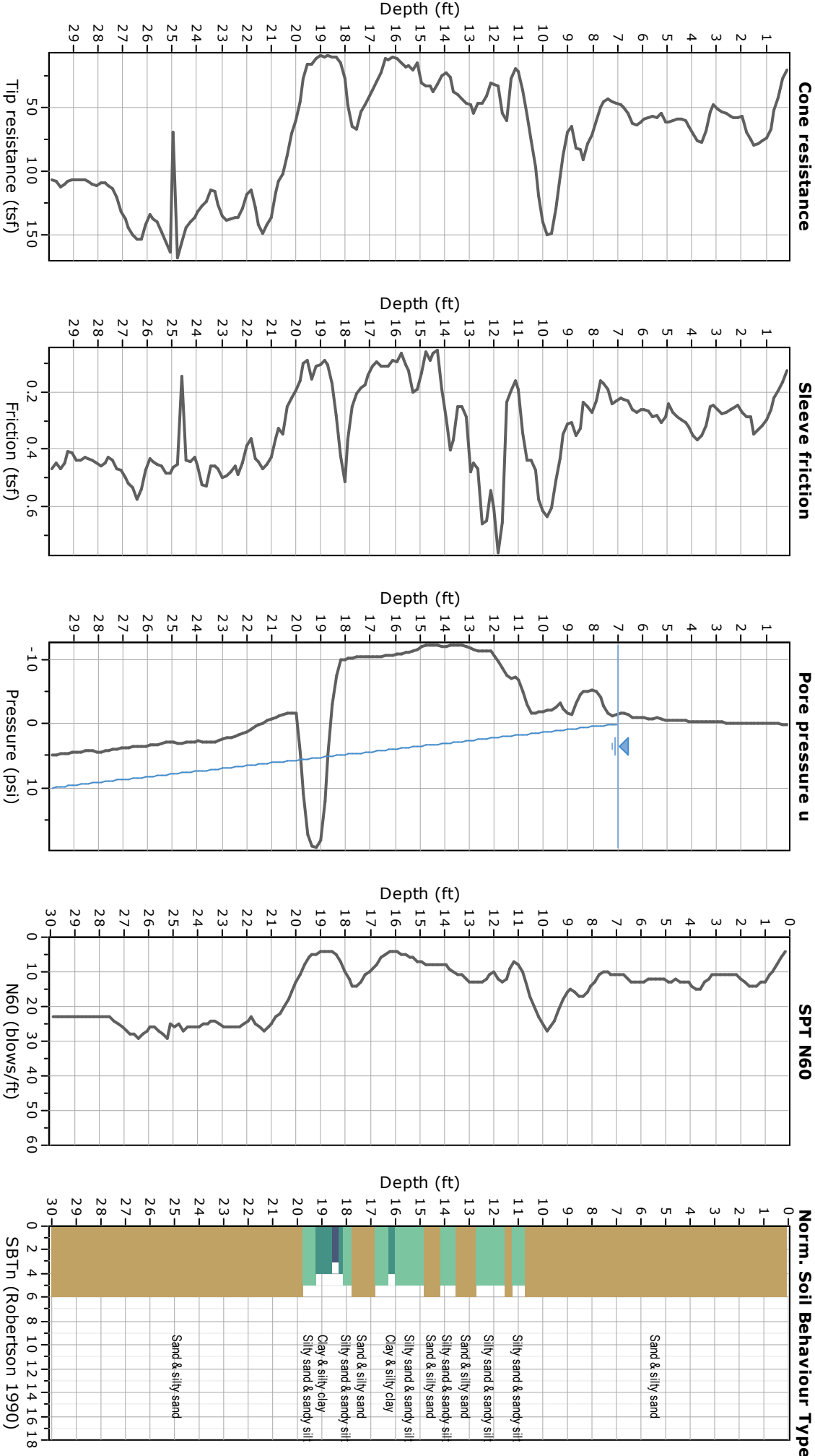




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ECS Project # 22-27313

Project: UNCW Parking Deck
Location: Wilmington, New Hanover County, North Carolina

CPT: S-9
Total depth: 29.86 ft, Date: 11/21/2018
Cone Operator: Cory Robinson





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Wilmington, NC 28405
ECS Project # 22-27313

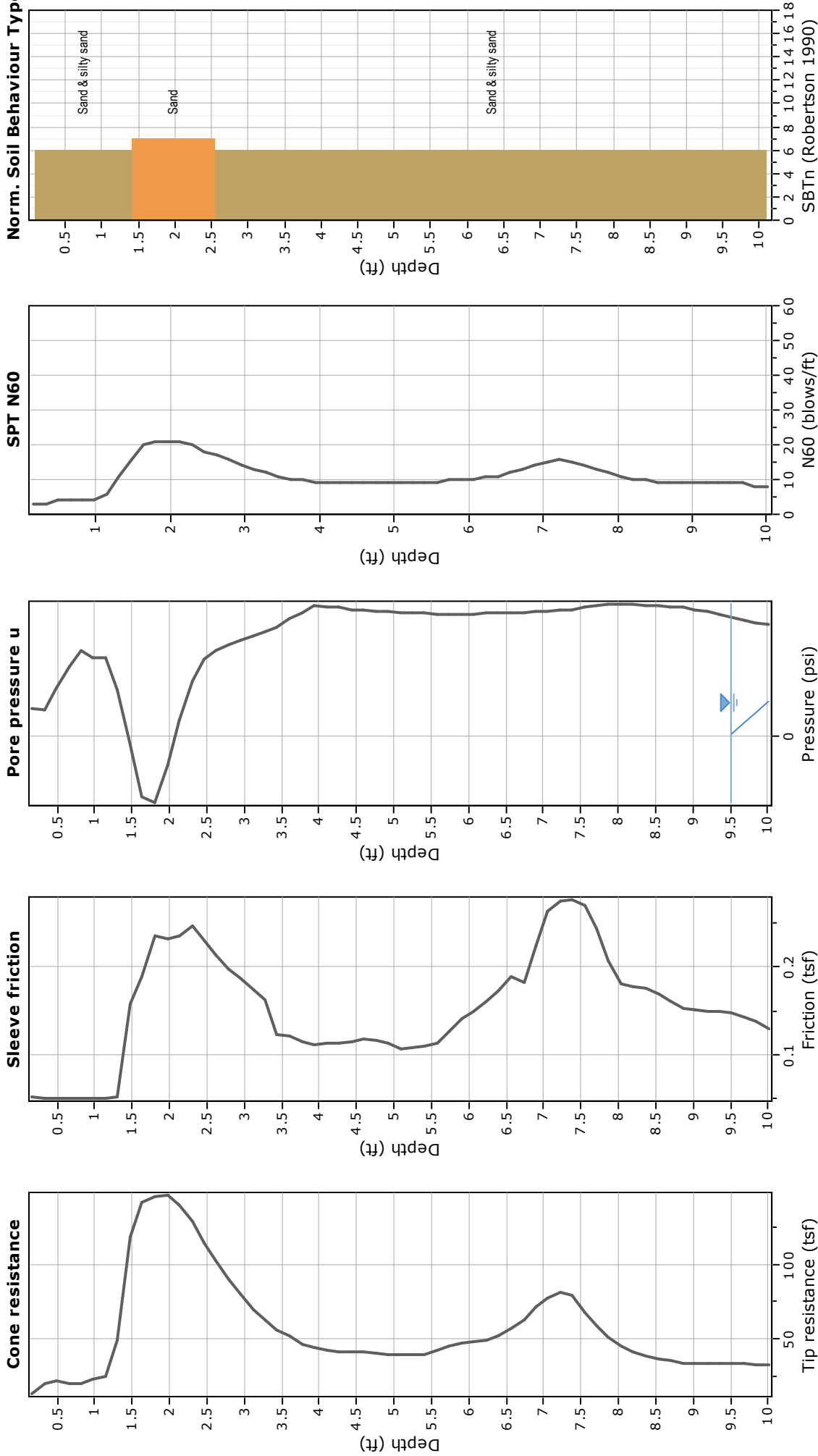
Project: UNCW Parking Deck

Location: Wilmington, New Hanover County, North Carolina

CPT: S-10

Total depth: 10.01 ft, Date: 11/21/2018

Cone Operator: Austin Fowler





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Wilmington, NC 28405
ECS Project # 22-27313

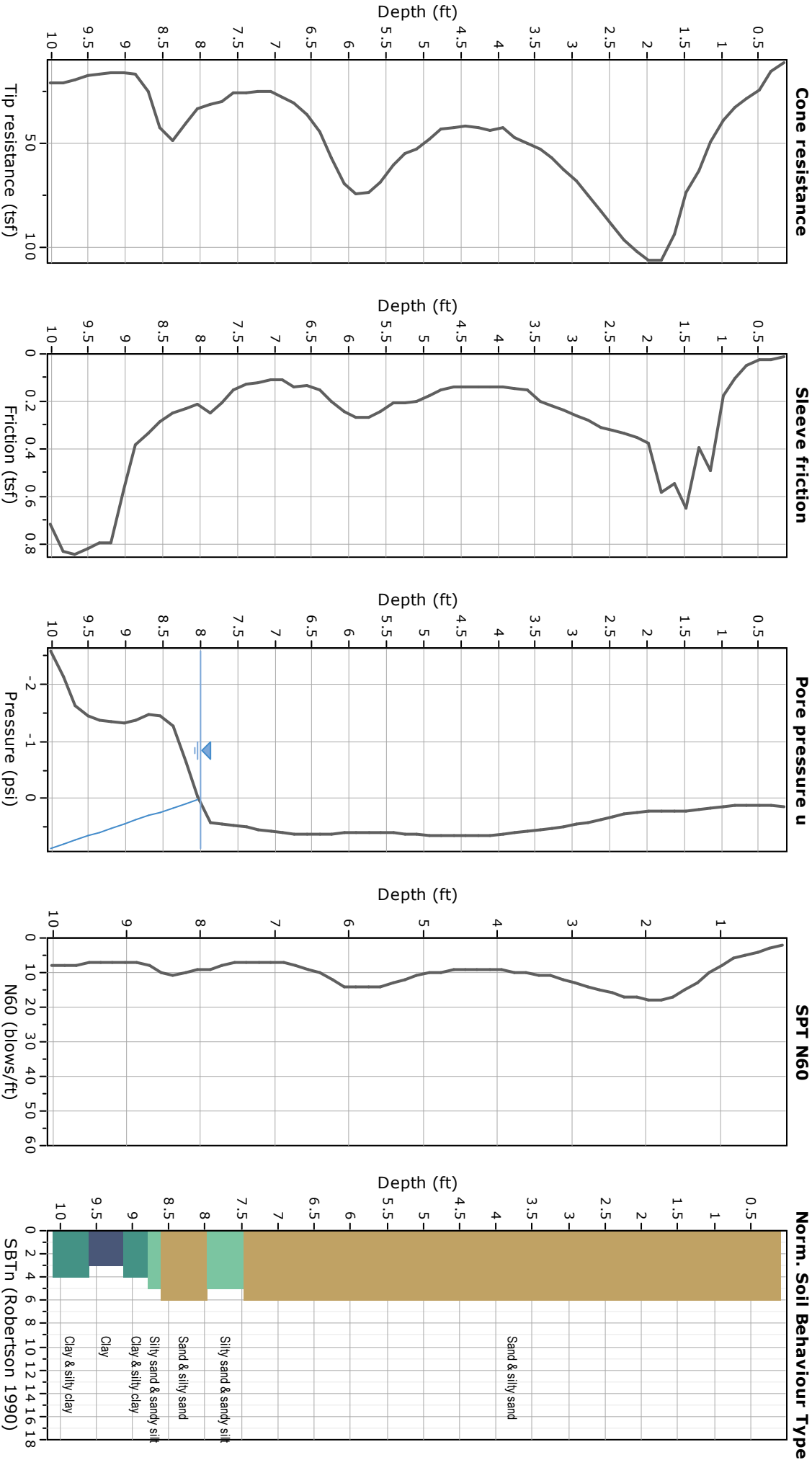
Project: UNCW Parking Deck

Location: Wilmington, New Hanover County, North Carolina

CPT: S-11

Total depth: 10.01 ft, Date: 11/21/2018

Cone Operator: Austin Fowler



CLIENT McKim & Creed				Job #: 22:27313		BORING # S-10		SHEET 1 OF 1				
PROJECT NAME UNCW Parking Deck				ARCHITECT-ENGINEER								
SITE LOCATION Riegel Road, Wilmington, New Hanover County, North Carolina												
NORTHING				EASTING		STATION				○ CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - REC% - - -		
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL		ENGLISH UNITS		WATER LEVELS	ELEVATION (FT)	BLOWS/6"	PLASTIC LIMIT% <input checked="" type="checkbox"/> WATER CONTENT% <input checked="" type="checkbox"/> LIQUID LIMIT% <input type="checkbox"/> ⊗ STANDARD PENETRATION BLOWS/FT
					BOTTOM OF CASING LOSS OF CIRCULATION							
					SURFACE ELEVATION							
0					Topsoil/Rootmat Depth [3"]							
					(SP FILL) FINE SAND PROBABLE FILL, Brown, Moist							
1					(SP FILL) FINE SAND PROBABLE FILL, Tan, Moist							
2												
3												
4					END OF BORING @ 4.0'							
5												
6												
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.												
WL		WS <input type="checkbox"/> WD <input type="checkbox"/>		BORING STARTED 11/20/18				CAVE IN DEPTH				
WL(SHW)		WL(ACR)		BORING COMPLETED 11/20/18				HAMMER TYPE				
WL				RIG FOREMAN				DRILLING METHOD Hand Auger				

DCP TEST DATA

Project: **UNCW Parking Deck**

Date: 20-Nov-18

Location: S-10

Soil Type(s): SAND (SP, SP FILL)

Hammer

☐ 10.1 lbs.

☒ 17.6 lbs.

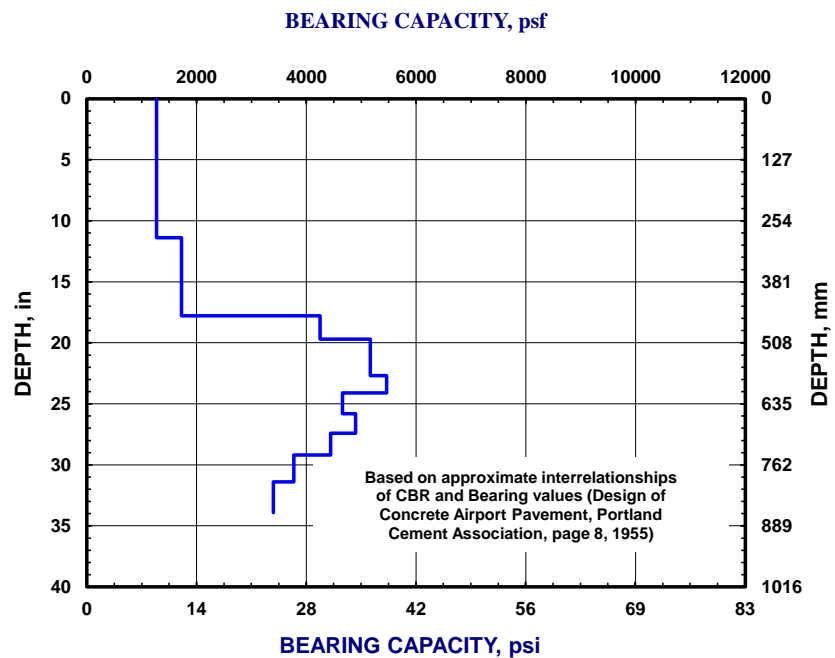
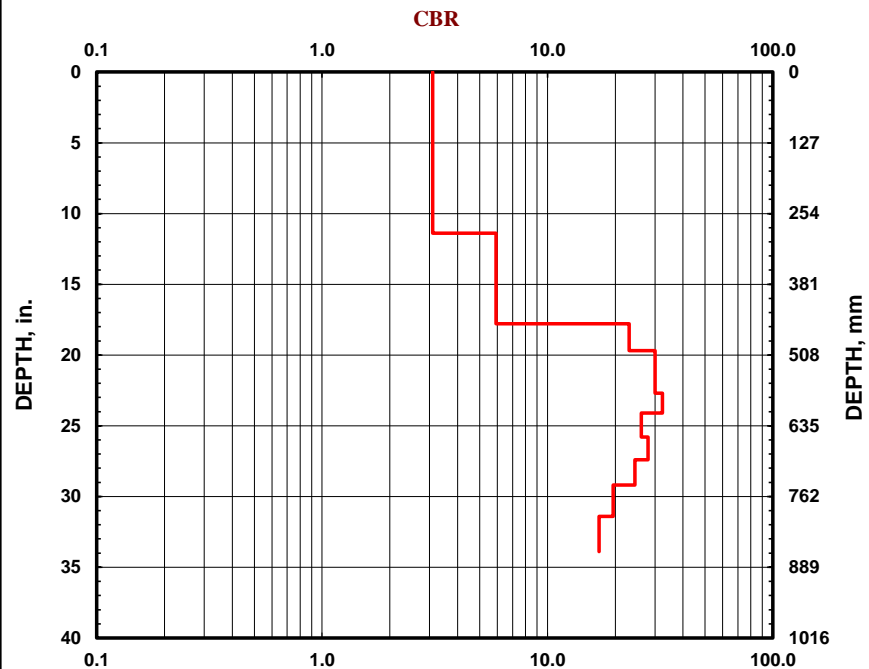
☐ Both hammers used

Soil Type

☐ CH

☐ CL

☒ All other soils

[illegible]

CLIENT McKim & Creed				Job #: 22:27313		BORING # S-11		SHEET 1 OF 1						
PROJECT NAME UNCW Parking Deck				ARCHITECT-ENGINEER										
SITE LOCATION Riegel Road, Wilmington, New Hanover County, North Carolina														
NORTHING				EASTING		STATION		—○— CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC% ———						
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL		ENGLISH UNITS		WATER LEVELS	ELEVATION (FT)	BLOWS/6"	PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% X ————— ● ————— △ ⊗ STANDARD PENETRATION BLOWS/FT		
					BOTTOM OF CASING LOSS OF CIRCULATION									
					SURFACE ELEVATION									
0					Topsoil/Rootmat Depth [3"]									
					(SP FILL) FINE SAND PROBABLE FILL, Brown, Moist									
1					(SP FILL) FINE SAND PROBABLE FILL, Tan, Moist, Contains Gravel									
2														
3														
4					END OF BORING @ 4.0'									
5														
6														

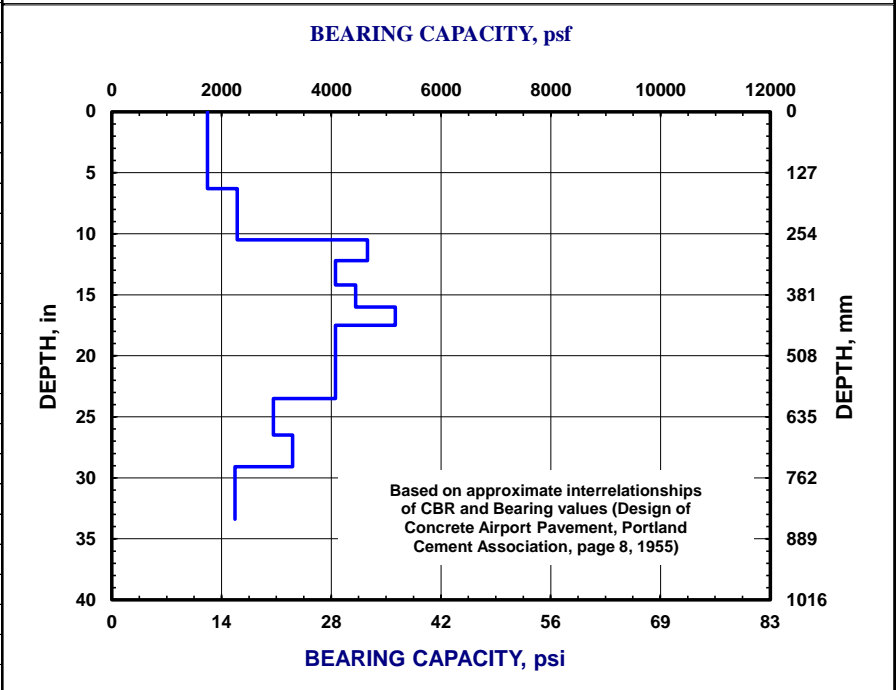
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL <input type="checkbox"/> WS <input type="checkbox"/> WD <input type="checkbox"/>	BORING STARTED 11/20/18	CAVE IN DEPTH
WL(SHW) <input type="checkbox"/> WL(ACR) <input type="checkbox"/>	BORING COMPLETED 11/20/18	HAMMER TYPE
WL <input type="checkbox"/>	RIG FOREMAN	DRILLING METHOD Hand Auger

DCP TEST DATA			
Project:	<u>UNCW Parking Deck</u>	Date:	<u>20-Nov-18</u>
Location:	<u>S-11</u>	Soil Type(s):	<u>SAND (SP, SP FILL)</u>
Hammer <input type="radio"/> 10.1 lbs. <input checked="" type="radio"/> 17.6 lbs. <input type="radio"/> Both hammers used		Soil Type <input type="radio"/> CH <input type="radio"/> CL <input checked="" type="radio"/> All other soils	

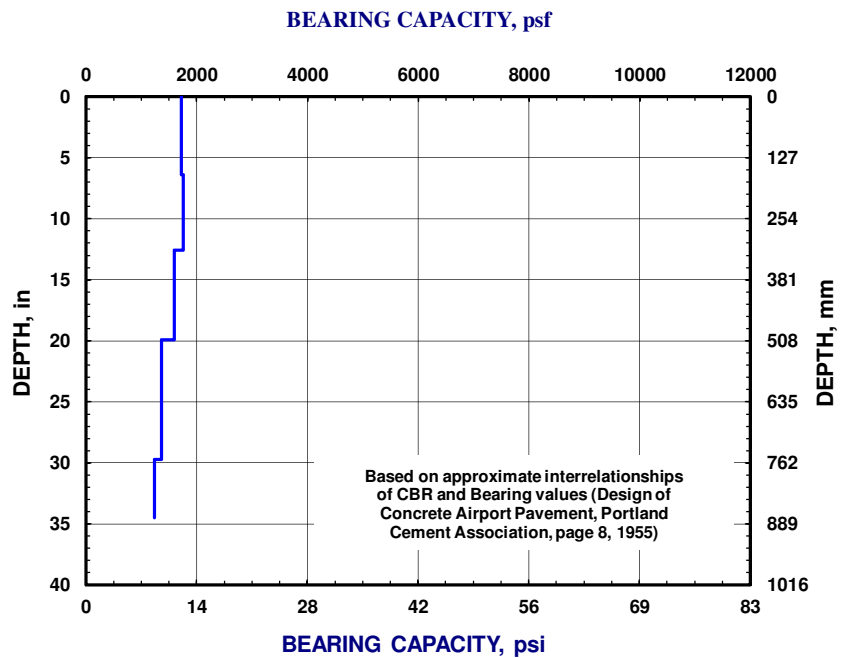
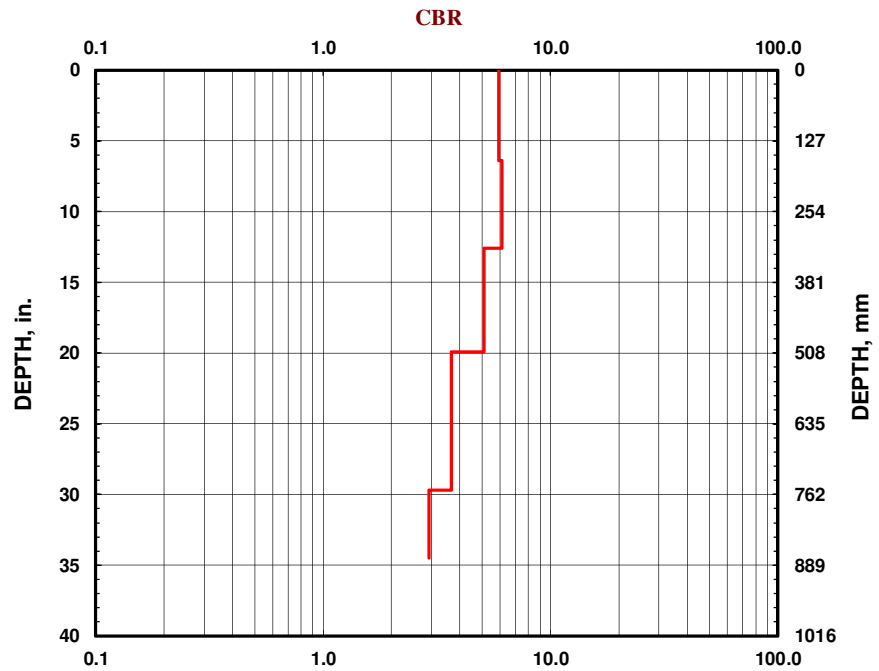
The graph displays the California Bearing Ratio (CBR) as a function of depth. The x-axis represents CBR on a logarithmic scale from 0.1 to 100.0. The left y-axis represents depth in inches from 0 to 40, and the right y-axis represents depth in millimeters from 0 to 1016. A red step-like line indicates the CBR values at various depths.

Depth (in.)	Depth (mm)	CBR
0	0	~6.0
5	127	~6.0
10	254	~10.0
12.5	318	~15.0
15	381	~10.0
17.5	445	~15.0
20	508	~10.0
25	635	~15.0
30	762	~10.0
35	889	~6.0
40	1016	~6.0



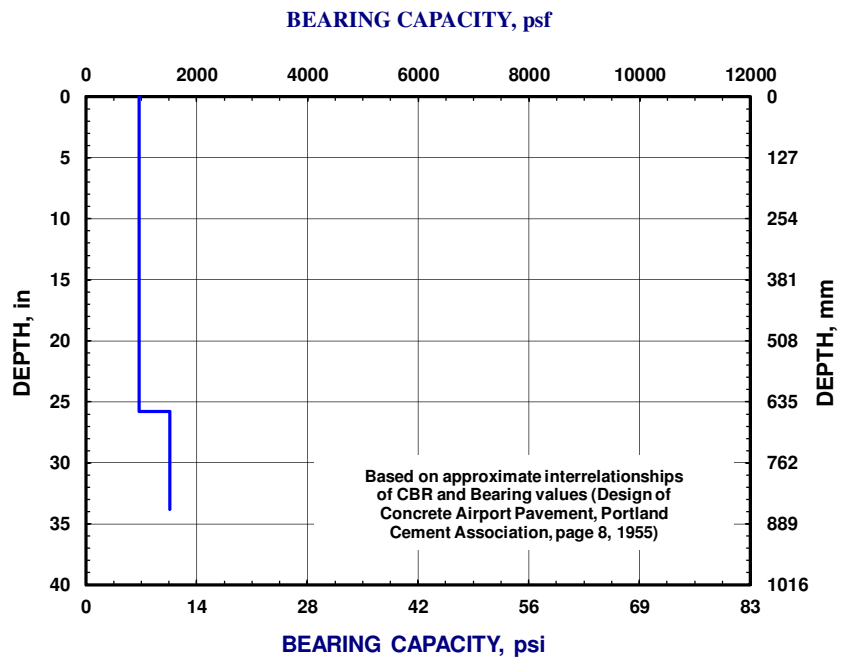
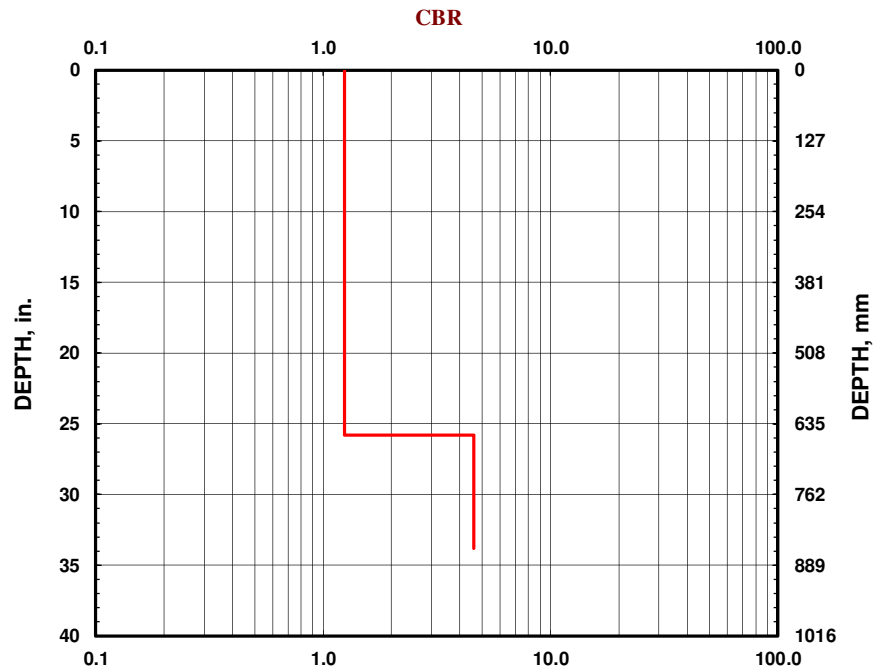
CLIENT		Job #:		BORING #	SHEET
UNCW		22:27497		HA-1	1 OF 1
PROJECT NAME		ARCHITECT-ENGINEER			
UNCW Parking Deck - West Lot					
SITE LOCATION					
Wilmington, North Carolina					
NORTHING		EASTING		STATION	
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL ENGLISH UNITS
					BOTTOM OF CASING LOSS OF CIRCULATION
					SURFACE ELEVATION
0					(SM) SILTY FINE TO MEDIUM SAND, gray/ brown, moist, trace gravel
1					(SP) FINE TO MEDIUM SAND, light gray/tan, moist
2					
3					
4					END OF BORING @ 4.0'
5					
6					
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.					
WL DRY		WS <input type="checkbox"/>	WD <input type="checkbox"/>	BORING STARTED	1/31/2019
WL(SHW)		WL(ACR)		BORING COMPLETED	1/31/2019
WL		RIG	FOREMAN	DRILLING METHOD Hand Auger	

DCP TEST DATA			
Project:	<u>UNCW Parking Deck - West Lot</u>	Date:	<u>31-Jan-19</u>
Location:	<u>HA-1</u>	Soil Type(s):	<u>SAND (SM, SP)</u>
Hammer <input type="radio"/> 10.1 lbs. <input checked="" type="radio"/> 17.6 lbs. <input type="radio"/> Both hammers used		Soil Type <input type="radio"/> CH <input type="radio"/> CL <input checked="" type="radio"/> All other soils	

[illegible]

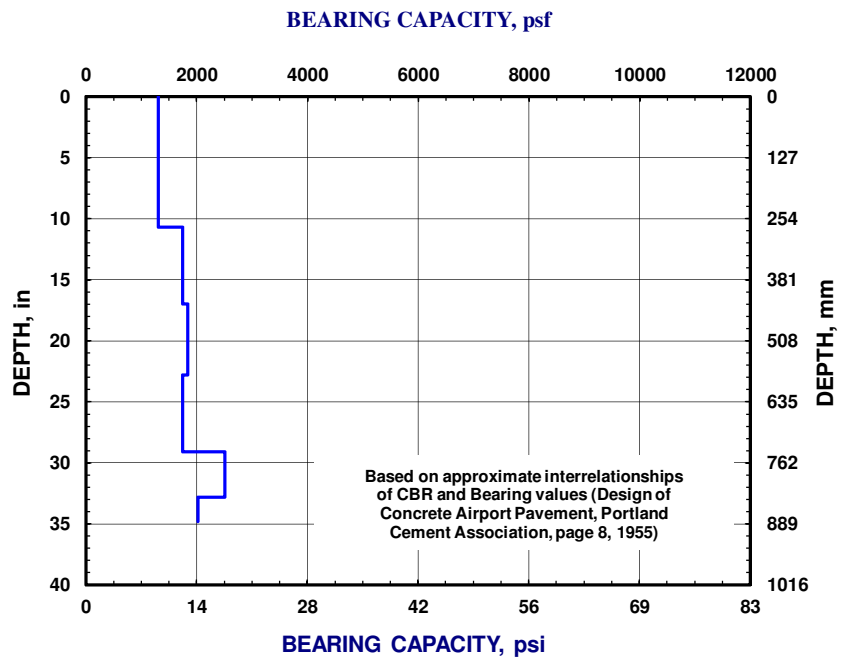
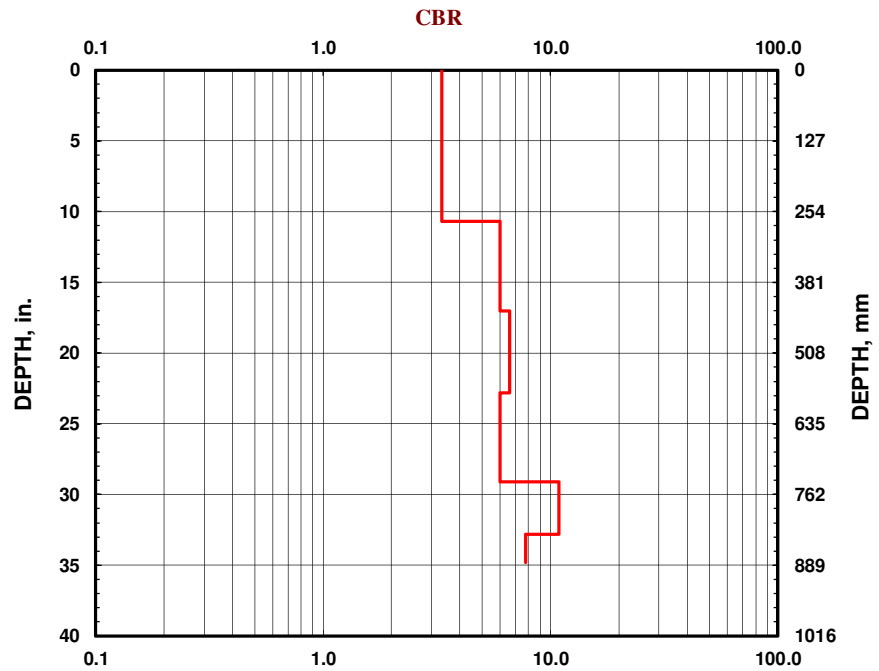
CLIENT UNCW				Job #: 22:27497		BORING # HA-2		SHEET 1 OF 1			
PROJECT NAME UNCW Parking Deck - West Lot				ARCHITECT-ENGINEER							
SITE LOCATION Wilmington, North Carolina											
NORTHING				EASTING		STATION		—○— CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC% ———			
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL		ENGLISH UNITS		WATER LEVELS ELEVATION (FT)	BLOWS/6"	PLASTIC LIMIT% ——— ● ——— LIQUID LIMIT% WATER CONTENT%
					BOTTOM OF CASING LOSS OF CIRCULATION						STANDARD PENETRATION BLOWS/FT
					SURFACE ELEVATION						
0					TOPSOIL/ROOTMAT [2"]						
					(SM) SILTY FINE TO MEDIUM SAND, dark gray, moist, trace roots						
1											
2					(SP) FINE TO MEDIUM SAND, light gray, moist						● 4.6
3											
4					END OF BORING @ 4.0'						
5											
6											
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.											
WL DRY		WS <input type="checkbox"/>		WD <input type="checkbox"/>		BORING STARTED 1/31/2019		CAVE IN DEPTH			
WL(SHW)		WL(ACR)				BORING COMPLETED 1/31/2019		HAMMER TYPE			
WL						RIG FOREMAN		DRILLING METHOD Hand Auger			

DCP TEST DATA			
Project:	UNCW Parking Deck - West Lot	Date:	31-Jan-19
Location:	HA-2	Soil Type(s):	SAND (SM, SP)
Hammer <input type="radio"/> 10.1 lbs. <input checked="" type="radio"/> 17.6 lbs. <input type="radio"/> Both hammers used		Soil Type <input type="radio"/> CH <input type="radio"/> CL <input checked="" type="radio"/> All other soils	

[illegible]

CLIENT UNCW				Job #: 22:27497		BORING # HA-3		SHEET 1 OF 1			
PROJECT NAME UNCW Parking Deck - West Lot				ARCHITECT-ENGINEER							
SITE LOCATION Wilmington, North Carolina											
NORTHING				EASTING		STATION		—○— CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC% ———			
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL		ENGLISH UNITS		WATER LEVELS ELEVATION (FT)	BLOWS/6"	PLASTIC LIMIT% ——— ● ——— LIQUID LIMIT% WATER CONTENT%
					BOTTOM OF CASING LOSS OF CIRCULATION						STANDARD PENETRATION BLOWS/FT
0					TOPSOIL/ROOTMAT [6"]		TOPSOIL/ROOTMAT [6"]				
1					(SM) SILTY FINE TO MEDIUM SAND, dark gravel brown/dark gray, moist, trace gravel from 1' to 2'		(SM) SILTY FINE TO MEDIUM SAND, dark gravel brown/dark gray, moist, trace gravel from 1' to 2'				
2					(SP) FINE TO MEDIUM SAND, light gray, moist		(SP) FINE TO MEDIUM SAND, light gray, moist				
3					(SM) SILTY FINE TO MEDIUM SAND, dark brown, wet		(SM) SILTY FINE TO MEDIUM SAND, dark brown, wet				
4					END OF BORING @ 4.0'		END OF BORING @ 4.0'				
5											
6											
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.											
WL DRY		WS <input type="checkbox"/>		WD <input type="checkbox"/>		BORING STARTED		1/31/2019		CAVE IN DEPTH	
WL(SHW)		WL(ACR)				BORING COMPLETED		1/31/2019		HAMMER TYPE	
WL						RIG		FOREMAN		DRILLING METHOD Hand Auger	

DCP TEST DATA			
Project:	<u>UNCW Parking Deck - West Lot</u>	Date:	<u>31-Jan-19</u>
Location:	<u>HA-3</u>	Soil Type(s):	<u>SAND (SM, SP)</u>
Hammer <input type="radio"/> 10.1 lbs. <input checked="" type="radio"/> 17.6 lbs. <input type="radio"/> Both hammers used		Soil Type <input type="radio"/> CH <input type="radio"/> CL <input checked="" type="radio"/> All other soils	

[illegible]

APPENDIX C – Laboratory Testing

Laboratory Test Results Summary
Natural Moisture Content Results
Moisture-Density Relationship Curves

Page 1 of 1

[illegible]

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method 1.

Definitions: MC: Moisture Content, Soil Type: AASHTO, LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index CBR: California Bearing Ratio, OC: Organic Content

Project No. 22.27313

Project Name: UNCW Parking Deck

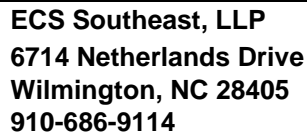
PM: Annemarie Crumrine

PE: Winslow Goins

Printed On: 2/4/19



ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405
Phone: (910) 686-9114



Moisture Content Worksheet (ASTM D2216)

Project Name	UNCW Parking Deck - West Lot	Project #	27497	Date	2/1/2019
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[illegible]

COMPACTION TEST REPORT

Curve No.: S-1

Project No.: 27497

Date: 2/1/19

Project: UNCW Parking Deck - West Lot

Client: McKim & Creed

Location: Onsite

Sample Number: S-1

Remarks:

MATERIAL DESCRIPTION

Description: Dark Brown, Silty, Fine to Medium Sand, Trace Clay

Classifications -

USCS:

AASHTO:

Nat. Moist. =

Sp.G. = 2.60

Liquid Limit =

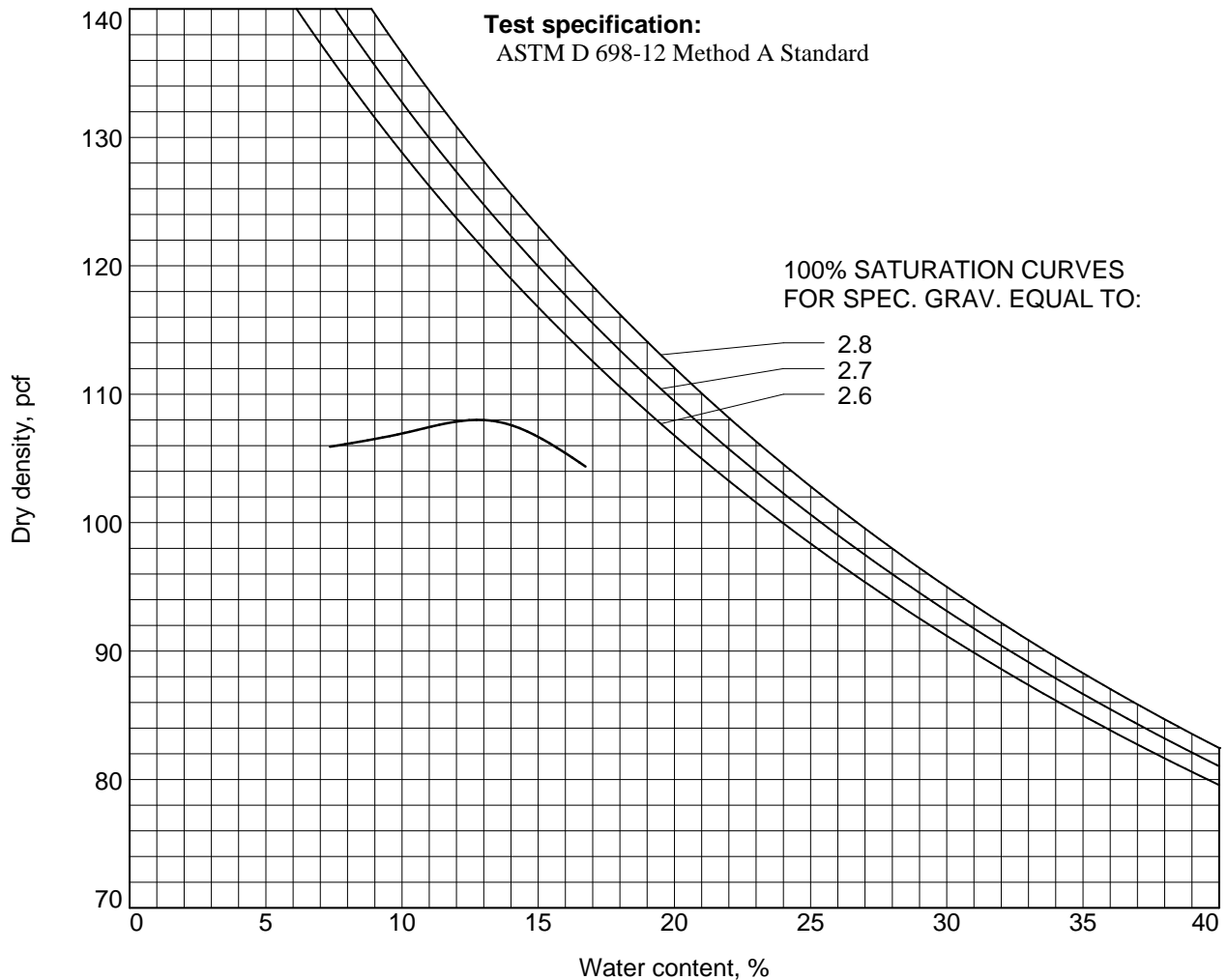
Plasticity Index =

% < No.200 =

TEST RESULTS

Maximum dry density = 108.0 pcf

Optimum moisture = 12.8 %



Figure

ECS Southeast, LLP

Tested By: EG Checked By: KEL

APPENDIX D – Seasonal High Water Table and Infiltration Testing Report

Seasonal High Water Table and Infiltration Testing Results



February 4, 2019

Mr. Richard Collier, P.E.
McKim & Creed
243 North Front Street
Wilmington, North Carolina 28401

Reference: Report of Seasonal High Water Table Estimation and Infiltration Testing
UNCW Parking Deck - West
Wilmington, New Hanover County, North Carolina
ECS Project No. 22.27497

Dear Mr. Collier:

ECS Southeast, LLP (ECS) recently conducted a seasonal high water table (SHWT) estimation and infiltration testing within the stormwater control measure (SCM) area(s) at Parking Lot L on the campus of UNCW in Wilmington, New Hanover County, North Carolina. This letter, with attachments, is the report of our testing.

Field Testing

On January 31, 2019, ECS conducted an exploration of the subsurface soil and groundwater conditions, in accordance with the NCDEQ Stormwater Design Manual section A-2, at one requested location shown on the attached Boring Location Plan (Figure 1). ECS used GPS equipment in order to determine the boring location. The purpose of this exploration was to obtain subsurface information of the in situ soils for the SCM area(s). ECS explored the subsurface soil and groundwater conditions by advancing one hand auger boring into the existing ground surface at each of the requested boring location. ECS visually classified the subsurface soils and obtained representative samples of each soil type encountered. ECS also recorded the SHWT and groundwater elevation observed at the time of the hand auger boring. The attached Infiltration Testing Form provides a summary of the subsurface conditions encountered at the hand auger boring locations.

The SHWT and groundwater elevation was estimated at the boring location below the existing grade elevation. A summary of the findings are as follows:

Location	SHWT	Groundwater
I-1	36 inches	55 inches

ECS has conducted two infiltration tests utilizing a compact constant head permeameter near the hand auger borings in order to estimate the infiltration rate for the subsurface soils. Infiltration tests are typically conducted at two feet above the SHWT or in the most restrictive soil horizon. Tests in clayey conditions are conducted for durations of up to 30 minutes. If a more precise hydraulic conductivity value is desired for these locations, then ECS recommends collecting samples by advancing Shelby tubes and performing laboratory permeability testing.

Field Test Results

Below is a summary of the infiltration test results:

Location	Description	Depth	Inches/ hour
I-1	Dark gray silty SAND	16 inches	0.21

Infiltration rates and SHWT may vary within the proposed site due to changes in elevation and subsurface conditions.

Closure

ECS's analysis of the site has been based on our understanding of the site, the project information provided to us, and the data obtained during our exploration. If the project information provided to us is changed, please contact us so that our recommendations can be reviewed and appropriate revisions provided, if necessary. The discovery of any site or subsurface conditions during construction which deviate from the data outlined in this exploration should be reported to us for our review, analysis and revision of our recommendations, if necessary. The assessment of site environmental conditions for the presence of pollutants in the soil and groundwater of the site is beyond the scope of this geotechnical exploration.

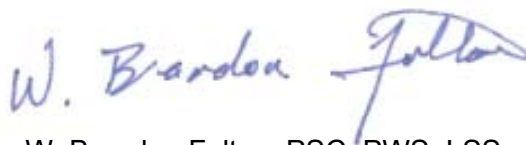
ECS appreciates the opportunity to provide our services to you on this project. If you have any questions concerning this report or this project, please contact us.

Respectfully,

ECS SOUTHEAST, LLP

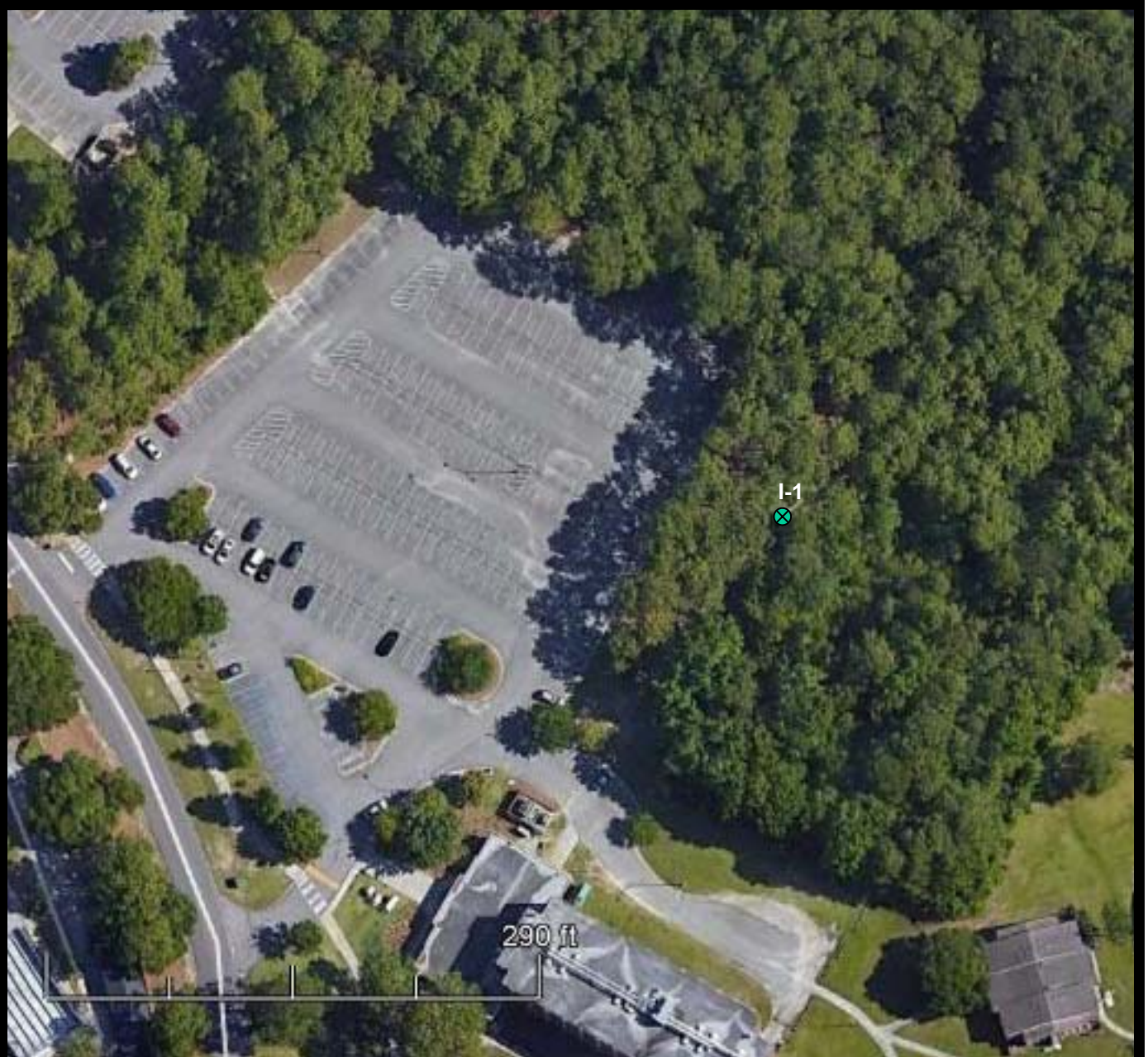


K. Brooks Wall
Project Manager
bwall@ecslimited.com
910-686-9114



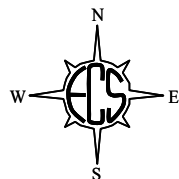
W. Brandon Fulton, PSC, PWS, LSS
Environmental Department Manager
bfulton@ecslimited.com
704-525-5152

Attachments: Figure 1 - Boring Location Plan
Infiltration Testing Form



APPROXIMATE BORING LOCATIONS

SCALE SHOWN ABOVE



**UNCW Parking Deck - West
Wilmington, New Hanover County,
North Carolina**

**ECS Project # 22.27497
January 31, 2019
KBW**



Figure 1– Boring Location Plan

Provided by: Google Earth

Infiltration Testing Form
UNCW Parking Deck - West
Shallotte, Brunswick County, North Carolina
ECS Project No. 22.27497
January 31, 2019

<u>Location</u>	<u>Depth</u>	<u>USCS</u>	<u>Soil Description</u>
I-1	0-6"	SM	Gray silty SAND
	6"-16"	SP	Tan fine SAND
	16"-20"	SM	Dark gray silty SAND
	20"-36"	SP	Gray fine SAND
	36"-60"	SM	Black silty SAND (hardpan)

Seasonal High Water Table was estimated to be at 36 inches below the existing grade elevation.

Groundwater was encountered at 55 inches below the existing grade elevation.

Test was conducted at 16 inches below existing grade elevation

Infiltration Rate: 0.21 inches per hour

APPENDIX E – Supplemental Report Documents

GBA Document

Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be, and, in general, if you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying it.* A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may

perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old*.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration*. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists*.



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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under separate contracts.
4. Access to site.
5. Work restrictions.
6. Specification and Drawing conventions.
7. Miscellaneous provisions.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: The University of North Carolina at Wilmington, Parking Deck II and Surface Parking (Design-Build), SCO#: 18-19226-01B, Code: 41828, Item: 30, Clark Nexsen Commission No. 8112

1. Project Location: UNC Wilmington 601 S. College Road, Wilmington, NC 28403-5906

- B. Owner: UNC Wilmington

1. Owner's Representative: Lisa Seifert, Project Manager, Facilities Management Building, 601 S. College Road, Wilmington, NC 28403-5906, Phone: 919.962.2360

- C. Architect: Gary Runions, Clark Nexsen, 1523 Elizabeth Avenue, Suite 300, Charlotte, North Carolina 28204.

- D. Architect's Consultants: Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Walker Consultants (Parking), 13860 Ballantyne Corporate Place Suite 140, Charlotte, North Carolina 28204, Phone: 704.247.6230
2. McKim & Creed (Civil and Landscaping), 1730 Varsity Drive, Suite 500, Raleigh, North Carolina 27606, Phone: 919.233.5261

- E. Design-Builder: Balfour Beatty Construction, LLC, Tony Stoneking, Project Manager, 406 South McDowell Street, Suite 200, Raleigh, NC 27601, Phone: 919.795.4954
 - 1. Design-Builder has been engaged for this Project to provide architectural and engineering services and to serve as Project's constructor. The terms "Design-Builder" and "Contractor" are synonymous.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. Demolition of part of an existing parking lot and construction of a new concrete precast parking deck. Work also includes modifications to the surface parking adjacent to the new parking deck.
- B. Type of Contract:
 - 1. Project will be constructed under a design-build contract.

1.5 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

1.6 ACCESS TO SITE

- A. General: Contractors shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project. Refer to section 013200 for work restrictions.
- B. General: Contractors shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Use of Site: Limit use of Project site to work in areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated on the drawing.
 - 1. Limits: Confine construction operations to area within the limits of construction as indicated the contract documents.
 - 2. Roads, Driveways, Entrances and Sidewalks: Keep construction driveways and entrances clear and available to emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Access for Deliveries: Road and sidewalk blockages shall be scheduled 72 hours in advance and may occur only after City of Wilmington and University approval. Warning signs, barricades, and detour information shall be placed as needed to accommodate, adequately warn, and protect pedestrians, including the handicapped. If required, flagmen shall direct traffic around the construction or detour area.

- b. Road and Sidewalk Closings: The contractor shall make requests for approval for any street, alley, entrance, driveway, access way, or sidewalk to be closed at least ten (10) work days prior to the date desired for closing. No such access will be closed without prior approval by the City of Wilmington and the University. Pedestrian and vehicle traffic way-finding around the construction limits must be maintained in a clean and safe condition at all times. Warning signs, barricades, and detour information shall be placed as needed to accommodate, adequately warn, and protect pedestrians, including the handicapped. If required, flagmen shall direct traffic around the construction or detour area.
 - c. Street Maintenance: Streets and adjacent property sites shall be kept free from run-off, litter and/or debris in any form from the project site and any that should appear shall be removed immediately. All mud collected on vehicle tires shall be removed before leaving the construction area. Adjacent roadways must be cleaned daily, if required, to prevent mud or dust from coating existing roadways. Contractors are prohibited from discharging any waste products from concrete trucks, concrete coring work, or any other unsuitable materials, fluids, or other products on the site, streets, or into the storm sewer system. Should the contractor fail to comply with these requirements, the University reserves the right, with twenty-four (24) hours' prior notice, to clean the offending area and deduct the cost from the Contractor's next application for payment.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Design-Builder and University two days in advance of proposed utility interruptions.
 - 2. Obtain Design-Builder and University written permission before proceeding with utility interruptions.
- C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Design-Builder not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Design-Builder's written permission before proceeding with disruptive operations.
- D. Restricted Substances: Use of tobacco products and other controlled substances is not permitted.
- E. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

- F. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.9 MISCELLANEOUS PROVISIONS

- A. Fire Arms: No fire arms, concealed or otherwise, are permitted on campus.
- B. Drug Free Workplace Requirement: The University is a drug-free work place. No drugs or alcohol are permitted on campus and employees on the work site under the influence of such substances shall be deemed sufficient cause for the University to permanently remove that individual from the project and University property. Such action shall not constitute grounds for a delay claim.
- C. Blasting: Blasting on University property is prohibited.
- D. Construction Site Fencing: A construction fence shall be installed around the perimeter of the project limits. The fence shall be constructed of heavy-duty chain link material, have a minimum height of six feet and shall have a continuous top tubular rail. Swing gates shall be included at every access to the enclosed area. The fence shall have an integral visual barrier or shading type material applied and maintained for the duration of the project. Gates will be interlocked with padlocks for which the University retains keys in order to allow access in case of an emergency. When the project is complete, fencing must be removed and ground contours restored to original condition or adjusted to coordinate with new construction. Upon project completion, grass must be mowed to a height to match adjacent grass height and damage to asphalt or striping within the site must be repaired.

- E. Site Maintenance: Contractor is responsible for maintaining a clean, organized, safe job site, free of accumulated construction debris and trash. To that end, Contractor shall be responsible for cleaning their work areas weekly at a minimum and the proper disposal of construction debris and trash. Debris shall be secured in trucks so that material cannot fall or be blown from trucks during transportation. Grass must be mowed or trimmed to keep height below 6" maximum length both within and within 24" of the construction limits. Demolition debris is not to remain on the project site. Contractors or subcontractors must provide their own dumpsters and provide for periodic dumping for demolition debris. Storm water runoff cannot adversely affect adjacent areas for the life of the project. Contractor must comply with the "Sedimentation Pollution Control Act of 1973" and ensure that erosion control measures are maintained for the duration of the project, until final ground cover is established.
- F. Materials/Equipment Storage: Storage of construction materials and equipment shall be limited to the project staging area unless otherwise agreed to, in writing, in advance. Should the Contractor fail to remove any material or equipment stored outside the staging area within twenty-four (24) hours of notification from the University, the University shall have the right to remove and dispose of such materials from the campus and deduct the cost of such removal and disposition from the Contractor's next application for payment.
- G. Security: The Owner will supply only the security measures required for University operations. The contractor shall provide the necessary security means to protect his work, materials, tools, and construction equipment from vandalism, theft, and fire. Watchman services shall be supplied by the contractor as he deems necessary. Any watchman service set up by the contractor shall be approved by the Owner. The contractor shall be responsible for replacement of his materials, machinery, equipment, tools and supplies due to theft or mysterious disappearance. All tools and equipment shall be clearly marked with the contractor's identification. All toolboxes shall be clearly marked by the contractor.
- H. Emergency Contacts: The contractor shall furnish the University with names, telephone numbers (day and night), and pager numbers of the project manager and superintendent prior to beginning work and maintain current information for the project duration.
- I. Protection of the Work: The Contractor shall protect all work in place. All materials, equipment, furnishings and finishes that are required to be new shall be in "new condition" at the time of final acceptance. Those that are deemed as not in "new condition" at the discretion of the Designer or Owner shall be removed and replaced at no additional cost to the Owner.
- J. Contractor's Employees – Respectful Behavior: All construction personnel shall be respectful of all members of the University community. Any incidents of disrespect, verbal abuse, threatening statements, unwelcome comments, unwelcome interaction or any form of harassment from any construction personnel toward any member of the University community is strictly prohibited. Any such act shall be deemed sufficient cause for the University to permanently remove any individual from the project and University property. Such action shall not constitute grounds for a delay claim.
- K. Contractor's Employees – Responsive Behavior: All construction personnel shall be responsive to requests to take action on any requirements of the contract documents and/or to correct any endangerment to the health and safety of the public. Any individual employee who ignores or refuses to take immediate action shall be identified as generating sufficient cause for the University to permanently remove them from the project and University property. Such action shall not constitute grounds for a delay claim.
- L. Utilities:

1. Provisions for Utilities:

All Utilities are the responsibility of the contractor and will be obtained and paid for directly by the Contractor. In some cases the contractor will be allowed to connect to on site University utilities such as water and electrical power but the contractor will be responsible for connection to these utilities and removal of connections once the project is completed.

2. Existing Utility Scheduled Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

- a. Notify the Design-Builder University Project Manager and Utility Company not less than five (5) business days in advance of any proposed utility interruptions.
- b. Do not proceed with utility interruptions without the Architect's written permission.

- 1) Utility Location/Interruptions: The contractor will obtain the services of a underground utility location company, experienced in the location and marking of underground utilities. The Contractor is responsible for locating all existing underground utilities prior to commencing excavation. The Contractor shall be responsible for the associated cost of any utility interruption and repair due to his excavation if utility location was not requested, location procedures performed and followed prior to commencing excavation. The Contractor shall immediately notify the University and restore the service of any utility disrupted due to excavation or any contractor action whatever the circumstance. The University reserves the right to immediately restore the service of any utility disrupted due to actions of the contractor and deduct the cost of such restoration from the contractor's contract.

- M. Signage: Job site trailer may display contractor's logo sign. Job site signage shall be as required for safety and traffic control. Project Construction Sign shall be constructed and installed in accordance with the details and specifications indicated in the construction documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for unit prices.

1.3 DEFINITIONS

- A. Unit price is an amount proposed by bidders a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all time, all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject General Contractor's (GC's) measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to GC.
- D. List of Unit Prices: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

- A. UNIT PRICING #1: \$_____ per cubic yard

1. Description: Removal, disposal by respreading on-site, and replacement of unsuitable soil and/or debris with a controlled backfill material from an on-site source.
2. Unit of Measurement: cubic yard of unsuitable soil measured and removed in original position.
3. Quantity Allowance:
 - a. Grading Subcontractor = 250 cubic yards
 - b. Concrete Subcontractor = 125 cubic yards

B. UNIT PRICING #2: \$_____per cubic yard

1. Description: Removal, disposal by respreading on-site, and replacement of unsuitable soil and/or debris with a controlled backfill material from an off-site source
2. Unit of Measurement: cubic yard of unsuitable soil measured and removed in original position.
3. Quantity Allowance:
 - a. Grading Subcontractor = 1,000 cubic yards
 - b. Concrete Subcontractor = 500 cubic yards

C. UNIT PRICING #3: \$_____per cubic yard

1. Description: Removal, disposal off-site, and replacement of unsuitable soil and/or debris with a controlled backfill material from an off-site source
2. Unit of Measurement: cubic yard of unsuitable soil measured and removed in original position.
3. Quantity Allowance:
 - a. Grading Subcontractor = 250 cubic yards
 - b. Concrete Subcontractor = 125 cubic yards

D. UNIT PRICING #4: \$_____each

1. Description: Providing a Test Pit for soils Engineer including removal, replacement, and re-compaction
2. Unit of Measurement: EACH for requested test pit
3. Quantity Allowance:
 - a. Grading Subcontractor = 5 each

E. UNIT PRICING #5: \$_____per cubic yard

1. Description: Removal, replacement, and re-compaction of existing loose fill under building or pavements areas
2. Unit of Measurement: cubic yard of loose soil measured and removed in original position
3. Quantity Allowance:
 - a. Grading Subcontractor = 250 cubic yards
 - b. Concrete Subcontractor = 125 cubic yards

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.
 - 3. The Contractor shall review all addenda, drawings, and specifications to fully appraise the extent of each alternate.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1A: Paint / Stain deck underside with a white finish with 1-year warranty. Paint all sprinkler and storm piping (includes vertical, horizontal and diagonal pipes).
- B. Alternate No. 1B: Paint / Stain vertical surfaces with a white finish with 1-year warranty.
- C. Alternate No. 2: Provide aluminum non-glazed frames at openings indicated in the architectural drawings. All stair windows and frames to remain in base bid.
- D. Alternate No. 3A: Add domestic water source from the southwest site new fire hydrant to the west side of the deck with a 2" reduced pressure backflow preventer, hotbox, domestic water booster pump, and 2" domestic water main stubbed into the deck.
- E. Alternate No. 3B: Provide 2" piping and two (2) hose connections on levels 1 through 5 at each end of ramp.
- F. Alternate No. 4: Provide brick edge banding at new sidewalks as indicated on the Civil Plans.
- G. Alternate No. 5: Provide 304 stainless steel stair railings in lieu of hot dipped galvanized.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for products selected under an alternate.
 - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use facsimile of form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those

- of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within five working days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 10 working days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.
- 1.5 QUALITY ASSURANCE
- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed unless otherwise indicated.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on form included in Project Manual.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within seven days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use forms provided in Project Bid Manual.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use sample copy included in Project Manual.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for approval by Owner and Contractor on the State construction interscope system.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on form included in Project Manual. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Bid Package.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.

- b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one- hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
- 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 - 6. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
 - 7. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work

- completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
- 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit five signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
- 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
- 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Products list (preliminary if not final).
 - 5. Submittal schedule (preliminary if not final).
 - 6. Certificates of insurance and insurance policies.
 - 7. Performance and payment bonds.
 - 8. Data needed to acquire Owner's insurance.
- H. Application for Payment at Final Acceptance: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
- 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - 2. This application shall reflect Certificate(s) of Final Acceptance issued previously

for Owner occupancy of designated portions of the Work.

- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706.
 5. AIA Document G706A.
 6. AIA Document G707.
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
 - 4. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

- A. RFI: Request for Information. Request from Owner, Construction Manager, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.
 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 14 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and in prominent location in built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.

2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing

- plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 - d. Locations and size of all equipment.
 6. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire- alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor- control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 7. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, support systems and sprinkler heads.
 8. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 9. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.

4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow three (3) working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 working days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project software.
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.

4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven calendar days if Contractor disagrees with response.

1.8 PROJECT MEETINGS

- A. General: Architect to schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Architect to inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
 2. Agenda: Architect to prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.
 - i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Submittal procedures.
 - l. Preparation of Record Documents.
 - m. Use of the premises and existing building.

- n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.

- w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for completing sustainable design documentation.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - k. Submittal procedures.
 - l. Owner's partial occupancy requirements.
 - m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.
 - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at monthly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future

- activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
1. PDF file.
- B. Startup construction schedule.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 3. Total Float Report: List of activities sorted in ascending order of total float.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Material Location Reports: Submit at monthly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Unusual Event Reports: Submit at time of unusual event.
- J. Qualification Data: For scheduling consultant.

1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final acceptance.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Final Acceptance: Indicate completion in advance of date established for Final Acceptance, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 2. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Uninterruptible services.
 - c. Partial occupancy before Final Acceptance.
 - d. Use-of-premises restrictions.
 - e. Environmental control.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Final Acceptance, and final completion.

- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate final completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 STARTUP CONSTRUCTION SCHEDULE

- A. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.8 CPM SCHEDULE REQUIREMENTS

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction

based on indicated activities.

- C. CPM Schedule: Prepare Contractor's Construction Schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
 4. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 5. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 6. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- F. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative

- dollar value.
- 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
- 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
- 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.
- G. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- H. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
 - 1. Submit unusual event reports directly to Owner within five calendar day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

- B. Related Requirements:

- 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements.
 - 3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and final completion construction photographs.
 - 5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.

11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.
 16. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals for electronic project software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.6 SUBMITTAL PROCEDURES

- A. General: Prepare and submit RFIs and Action Submittals required by individual Specification Sections. Submittals shall be made in a single package and shall include all product information showing compliance with specifications (product data, shop drawings, manufacturers' written recommendations, test reports, colors, samples, certificates, etc. that are applicable to that product). Incomplete submittals will be rejected and not reviewed.
1. Submit electronic submittals directly to the Architect/Engineer through the project tracking *Newforma Info Exchange* site specifically established for the Project.
 - a. Use of other project tracking software, website, utility, etc. is permitted for the contractors use only, but all submittals are to be forwarded to the Architect/Engineer through the *Newforma Info Exchange* site for tracking. The designer will not accept submissions from an alternate transfer application.
 - b. Electronic submittals must be in *Portable Document Format* (PDF) file format for submission. Other file type's native to other software/systems will not be accepted. It is the responsibility of the contractor to convert any electronic information to PDF format prior to submission.
 - c. Electronic information will be transmitted back to the contractor using the Newforma Info Exchange site and will not be uploaded to any other electronic platform.
 - d. Submit electronic information to CACLT@ClarkNexsen.com
 - e. Submittal content must be complete and provided in the same sequential order as the listed in the submittal section.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 14 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 14 calendar days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 20 calendar days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 14 calendar days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- D. Designer's Action:
1. Designer will not review submittals that do not bear the General Contractor's approval stamp and will return them without action. Designer will not review incomplete submittals and will return them without action.
 - a. Submittals received on normal business days prior to 3:00 pm EST will be logged in on that day. Submittals received after 3:00 pm EST will not be logged in until the next normal business day. Submittals received on Saturdays and Sundays will not be logged in until the following Monday or the next normal business day. Any submittals received on a nationally recognized holiday in the United States will not be logged in until the next normal business day.
- E. Resubmittals: Produce resubmittals in the same format and number of copies as initial submittal with the same title.

1. Note date and content of previous submittal on the transmittal sheet.
 2. Note date and content of revision on the label or title block of the transmittal sheet and clearly indicate extent of revision by adding the suffix of either .01, or -01 as it pertains to the revision number.
 3. Package all Action Submittal information into a single submittal package as listed in the specification section for Action Submittals. A single submittal package shall include product data, sample warranties, color selections, samples, shop drawings, certificates, qualification data, reports, procedures, and other items as required for that specification division of work. Incomplete submittals will not be reviewed by the Architect/Engineer and returned as rejected.
 4. Package all Informational Submittal information into a single submittal package as listed in the individual specification section for Informational Submittals. A single submittal package shall include test and evaluation reports, certificates, and other items as required for that division of work.
 5. Submit Action Submittals and Informational Submittals simultaneously.
 6. Resubmit submittals until they are marked "Approved" or "Approved as Noted".
 7. The Architect/Engineer will not accept any submittals directly from the subcontractors. The contractor is solely responsible for management of the subcontractor's submittals. Any submittals received by the Architect/Engineer from sources other than the contractor will be discarded without review.
- F. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- G. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.

- d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 - 4. Electronic Project Software: Prepare submittals in PDF form, and upload to electronic project software. Enter required data in electronic project software site to fully identify submittal.
 - 5. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
 - 6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units

or sections of units showing the full range of colors, textures, and patterns available.

- a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least two sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying

that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.9 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 2. Submittals by electronic project software: Architect will indicate the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality- assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged. Subcontractors to include all provisions to complete mock-ups at CMAR request.
1. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; equipment; and lighting
 2. Exterior Mockups: Mock-up of typical exterior building construction. Mock-up to be free standing 8'x8' and include materials not to be re-used on the buildings. Provisions for (1) freestanding mock-up shall be assumed for each building. The mock-up shall re-main onsite until authorized by CMAR for removal.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.5 CONFLICTING REQUIREMENTS

- A. **Conflicting Standards and Other Requirements:** If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 ACTION SUBMITTALS

- A. **Shop Drawings:** For mockups.
 - 1. Include plans, sections, and elevations, indicating materials and size of mockup construction.
 - 2. Indicate manufacturer and model number of individual components.
 - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. **Delegated-Design Services Submittal:** In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.7 INFORMATIONAL SUBMITTALS

- A. **Contractor's Quality-Control Plan:** For quality-assurance and quality-control activities and responsibilities.
- B. **Qualification Data:** For Contractor's quality-control personnel.
- C. **Contractor's Statement of Responsibility:** When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. **Testing Agency Qualifications:** For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
 2. Entity responsible for performing tests and inspections.
 3. Description of test and inspection.
 4. Identification of applicable standards.
 5. Identification of test and inspection methods.
 6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.
- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections including Subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.

- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, telephone number, and email address of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of

manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 8. Demolish and remove mockups when directed unless otherwise indicated.

1.11 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those

- required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- C. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- F. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality- control services required by the Contract Documents as a component of Contractor's quality- control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 – PRODUCTS(Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200-REFERENCES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such

standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
 - 1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
 - 2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 - 3. ICC - International Code Council; www.iccsafe.org.
 - 4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up-to-date as of the date of the Contract Documents.
 - 1. COE - Army Corps of Engineers; www.usace.army.mil.
 - 2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
 - 3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 - 4. DOD - Department of Defense; <http://dodssp.daps.dla.mil>.
 - 5. DOE - Department of Energy; www.energy.gov.
 - 6. EPA - Environmental Protection Agency; www.epa.gov.
 - 7. FAA - Federal Aviation Administration; www.faa.gov.
 - 8. FG - Federal Government Publications; www.gpo.gov.
 - 9. GSA - General Services Administration; www.gsa.gov.
 - 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 - 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; <http://eetd.lbl.gov>.
 - 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 - 13. SD - Department of State; www.state.gov.
 - 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; www.trb.org.

15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeia; www.usp.org.
 19. USPS - United States Postal Service; www.usps.com.
- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 2. DOD - Department of Defense; Military Specifications and Standards; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
 3. DSCC - Defense Supply Center Columbus; (See FS).
 4. FED-STD - Federal Standard; (See FS).
 5. FS - Federal Specification; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
 6. MILSPEC - Military Specification and Standards; (See DOD).
 7. USAB - United States Access Board; www.access-board.gov.
 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF - State of California; Department of Consumer Affairs; Bureau of Electronic Appliance and Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 2. CCR - California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 3. CDHS - California Department of Health Services; (See CDPH).
 4. CDPH - California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 5. CPUC - California Public Utilities Commission; www.cpuc.ca.gov.
 6. SCAQMD - South Coast Air Quality Management District; www.aqmd.gov.
 7. TFS - Texas Forest Service; Forest Resource Development and Sustainable Forestry; <http://txforests.service.tamu.edu>.

The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, Engineer, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion and Sedimentation Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire prevention program.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts, 2-7/8-inch-OD corner and pull posts and 1-5/8-inch-OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide bases for supporting posts.
- C. Wood Enclosure Fence: Plywood, 6 feet high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Engineer, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- F. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- H. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead unless otherwise indicated.
 - 2. Connect temporary service to Owner's existing power source, as directed by Owner.
- J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- K. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line for each field office.
 - 1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine in each field office.
 - 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 - 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- L. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect, Engineer and Owner to access project electronic documents and maintain electronic communications. Equip computer with not less than the following:
 - 1. Processor: Intel Pentium D or Intel CoreDuo, 3.0 GHz processing speed.
 - 2. Memory: 4 gigabyte.
 - 3. Disk Storage: 300 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
 - 4. Display: 22-inch LCD monitor with 128 Mb dedicated video RAM.
 - 5. Network Connectivity: 10/100BaseT Ethernet.
 - 6. Productivity Software:
 - a. Microsoft Office Professional, XP or higher, including Word, Excel, and Outlook.

- b. Adobe Reader 7.0 or higher.
 - c. WinZip 7.0 or higher.
- 7. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
 - 8. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 384 Kbps upload and 1 Mbps download speeds at each computer.
 - 9. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

- 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
- 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.

- 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

- 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
- 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
- 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 321216 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

- 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
- 2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Provide temporary parking areas for construction personnel.

- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touchup signs so they are legible at all times.
- H. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- K. Temporary Elevator Use: Use of elevators is not permitted.
- L. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- M. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing."

- D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion and sedimentation control Drawings.
- E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- H. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- K. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Discard or replace water-damaged and wet material.
 4. Discard, replace, or clean stored or installed material that begins to grow mold.
 5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 015713 – TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section covers the furnishing of materials, labor, and equipment necessary to minimize erosion, siltation, and pollution on the project covered by these specifications.
- B. The Contractor shall take whatever measures are necessary to minimize soil erosion and siltation, water pollution, and air pollution. The Contractor shall also comply with the applicable regulations of all legally constituted authorities relating to pollution prevention and control. The Contractor shall keep himself fully informed of all such regulations that in any way affect the conduct of the work. In the event of conflict between such regulations and the requirements of these specifications, the more restrictive requirements shall apply.
- C. Failure on the part of the Contractor to perform the necessary measures to control erosion, siltation, and pollution will result in the Engineer notifying the Contractor to take such measures. In the event that the Contractor fails to perform such measures within 24 hours after receipt of such notice, the Engineer may suspend the work with no extension of contract time, or may proceed to have such measures performed by others at the Contractor's expense, or both.

1.2 RELATED WORK IN OTHER SECTIONS

- A. Turf and Grasses Section 329200

1.3 QUALITY ASSURANCE

- A. Erosion and sedimentation control shall conform to the requirements of the NCDEMLR – Division of Land Quality and the North Carolina Sediment Pollution Control Act of 1973 (or latest revision) or all current applicable local ordinances whichever is more stringent.

PART 2 - PRODUCTS

- 2.1 Seeding and mulching materials shall conform to the requirements of Section 329200.
- 2.2 Silt fences shall conform to the details shown on plans.

PART 3 - EXECUTION

- 3.1 The Contractor shall exercise every reasonable precaution throughout the life of the project to prevent the eroding of soil and the siltation of rivers, streams, lakes, reservoirs, ditches, ground surfaces, or other property. Should any erosion or siltation occur the Contractor should take immediate action to correct the situation. The Contractor shall remove and properly dispose of any material washed into rivers, streams, lakes, reservoirs, ditches, storm sewers, or other property. Should any erosion or siltation occur into rivers, streams, lakes, reservoirs, or waterways, the contractor shall immediately contact the appropriate regulatory agency and engineer for directions or proper remediation. The Contractor shall be liable for any damage to private or public property resulting from insufficient erosion and siltation control measures.
- 3.2 Construction operations in rivers, streams, ditches, and water impoundments shall be restricted to those areas that must be entered for the performance of work shown on the plans. Excavated materials shall not be deposited in rivers, streams, ditches, or impoundments except that

temporary earth dikes may be used when approved by the Engineer, but such dikes shall be completely removed in such manner as to prevent siltation. Frequent fording of flowing streams with equipment will not be permitted. Temporary bridges or other structures shall be used wherever frequent stream crossings are necessary.

- 3.3 Temporary and permanent erosion control measures shall be provided as shown on the plans or as directed by the Engineer. Temporary sediment control devices must be installed to the extent possible prior to initiation of grading and excavation. The devices must be maintained at a minimum of 50% of the original sediment storage capacity and may not be removed until the areas they serve have been stabilized. Temporary erosion control measures shall include, but not be limited to, the use of temporary berms, dikes, drainage ditches, silt basins, silt ditches, slope drains, structures, stone check dams, vegetation, mulches, mats, netting, gravel, or other necessary methods. Temporary erosion control may include work outside the construction limits.
- 3.4 The Engineer may limit the area over which excavation, embankment, and grading operations are performed whenever the Contractor's operations are not effectively minimizing erosion and/or siltation.
- 3.5 All disturbed, non-paved areas shall be seeded and fertilized, mulched, and tacked as soon as practical after cleanup in accordance with the detailed technical specifications therefore. In no case shall a total area of one acre or more be left ungrassed for a period of twenty-one (21) calendar days when construction has been completed in the area.
- 3.6 The Contractor shall take every precaution throughout the life of the project to prevent the pollution of rivers, streams, and water impoundments. Pollutants such as chemicals, fuels, lubricants, bitumens, sewage, and other harmful waste shall not be discharged into or alongside rivers, streams, or impoundments, or into natural or manmade channels leading thereto. The Contractor shall also comply with all Federal, State, and local water and air pollution laws.
- 3.7 Contractor shall maintain all erosion control measures until the appropriate State authority approves and releases the site at which time the Contractor shall remove all erosion control measures as directed by the Engineer.
- 3.8 Contractor shall keep complete record of all applicable erosion control and stormwater management inspections onsite.

END OF SECTION 015713

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for products selected under an alternate.
 - 2. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 3. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that

a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications. Submit a comparable product request, if applicable.

1.4 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

- a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
3. See individual identification sections in Divisions 21, 22, 23, and 26 for additional identification requirements.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
 - 1. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
 - 2. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
 - a. Non-limited list of products is indicated by the phrase: "Subject to

compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."

3. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
4. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service

- performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 - 2. Evidence that proposed product provides specified warranty.
 - 3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - 4. Samples, if requested.
- B. Submittal Requirements: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 – EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

- B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- E. Certified Surveys: Submit two copies signed by professional engineer.
- F. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.

- i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
- 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
- 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements

in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project

site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be

factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
 - 2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 4. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Final Acceptance.
- C. Certified List of Incomplete Items: Final submittal at final completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 FINAL ACCEPTANCE PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Final Acceptance: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Final Acceptance. List items below that are incomplete at time of request.
 - 1. Submit testing, adjusting, and balancing records.
- C. Procedures Prior to Final Acceptance: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 - 5. Advise Owner of changeover in utility services.
 - 6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 8. Complete final cleaning requirements.
 - 9. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Final Acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 - 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Section 012900 "Payment

- Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit final completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF electronic file. Architect will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Final Acceptance, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
- a. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - b. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - c. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - d. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - e. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.

- I. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
 - p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
 - C. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored,

provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA PART

1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
 2. Submit three paper copies. Architect will return two copies.
- A. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- B. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- C. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Architect.
 7. Name and contact information for Commissioning Authority.
 8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 9. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 - 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 - 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 - 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 - 1. Fire.
 - 2. Flood.
 - 3. Gas leak.
 - 4. Water leak.
 - 5. Power failure.
 - 6. Water outage.
 - 7. System, subsystem, or equipment failure.
 - 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating

personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents.

Identify data applicable to the Work and delete references to information not applicable.

- a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and one of file prints.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

- D. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.

- C. Format: Submit record Product Data as annotated PDF and electronic file paper copy.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's and Construction Manager's reference during normal working hours.

PART 2 – PRODUCTS

PART 3 – EXECUTION

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 - 3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video

recording on each page.

4. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 2. Documentation: Review the following items in detail:

- a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.

- g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEORECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training

video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.
 1. Submit video recordings on CD-ROM or thumb drive.
 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS PART

3 - EXECUTION

END OF SECTION 017900

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, finishes, and other miscellaneous items related to cast-in-place concrete.
- B. Cast-in-place concrete includes project requirements specified herein and on the drawings:
 - 1. Water/Cementitious Materials Ratio: See General Notes on Drawings.
 - 2. Entrained Air: See General Notes on Drawings.
 - 3. Water Reducing Admixture: See Part 2 Article "Admixtures."
- C. Related Sections:
 - 1. Division 01 Section "Quality Control"
 - 2. Division 03 Section "Precast Concrete"
 - 3. Division 07 Section "Traffic Coatings"
 - 4. Division 07 Section "Water Repellents"
 - 5. Division 07 Section "Concrete Joint Sealants"
 - 6. Division 07 Section "Expansion Joint Assemblies"
 - 7. Division 09 Section "Painting"
 - 8. Division 09 Section "Pavement Marking"

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag.
- B. Self-Consolidating Concrete (SCC): Highly flowable, non-segregating concrete that can spread into place, fill the formwork, and encapsulate the reinforcement without any mechanical consolidation.

1.4 SUBMITTALS

- A. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions.

Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner will in turn reimburse Engineer.

B. Requests For Information:

1. Engineer reserves the right to reject, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

C. Submit Product data for concrete component materials and other concrete related items, including, but not limited to:

1. Material Certificates: Signed by Manufacturer that each of the following items complies with requirements:
 - a. Cementitious materials and aggregates
 - b. Admixtures
 - c. Form materials and form-release agents
 - d. Steel reinforcement and accessories
 - e. Waterstops
 - f. Curing materials
 - g. Floor and slab treatments
 - h. Bonding agents
 - i. Vapor barriers/reducer
 - j. Repair materials
2. Submit certification that evaporation reducer, if used, is compatible with traffic coatings specified in Division 7 Section "Traffic Coatings", sealants specified in Division 7 Sections "Concrete Joint Sealants", and expansion joint assemblies specified in Division 7 Section "Expansion Joint Assemblies."
3. Submit certification that evaporation reducer, if used, is compatible with pavement markings specified in Division 9 Sections "Painting" and "Pavement Marking."

D. Submit calculations and dimensions for "Nominal Form Width" for linear gap at time of forming or erecting concrete elements bounding the expansion joints in accordance with Drawings and Specification "Expansion Joint Assemblies".

E. Submit concrete mixture proportions to Engineer for each concrete mixture. Submit alternate mixture proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Provide mixture proportions not less than four weeks before placing concrete and not less than one week before pre-installation conference (pre-concrete meeting).
2. Proportion mixtures as defined in ACI 301 Section 4 header "Proportioning," Mixtures shall be proportioned by party other than Testing Agency responsible for testing Project concrete.
3. Proportion mixtures to minimize effects of thermal and drying shrinkage. See Part 2 heading "Concrete Mixtures" header "Shrinkage" for drying shrinkage limit.
4. Use mixture proportions submission form at end of this Section for each concrete mixture,

which identifies the following:

- a. Mixture Proportions Identification and use.
 - b. Method used for documentation of required average compressive strength, (ACI 301 Section 4 – *Field test data* or *Trial mixtures*).
 - c. Gradation of fine and coarse aggregates.
 - d. Proportions of all ingredients including all admixtures added either at time of batching or at job site.
 - e. Water/cementitious materials ratio.
 - f. Slump, ASTM C143.
 - g. Air Content:
 - 1) Of freshly mixed concrete by pressure method, ASTM C231, or volumetric method, ASTM C173.
 - 2) Of hardened concrete by microscopical determination, including parameters of air-void system, ASTM C457.
 - h. Freeze-thaw resistance, ASTM C457 and C666. If super-plasticized concrete cannot meet hardened air content requirements of Part 2, ASTM C666 laboratory test result of specimens with concrete mixture proportions similar to proposed mixture for project shall be submitted for review by Engineer. Report air void parameters (spacing and specific surface area in accordance with ASTM C457) (at point of placement) of specimens tested. Test specimens shall contain specified air system (within plus or minus 1.5 percent) and high-range water-reducer (superplasticizer) used in concrete for project. Report relative durability factor of concrete for specimens tested in accordance with Procedure A of ASTM C666. Acceptable concrete durability factor greater than 90 percent ($> 90\%$) at 300 test cycles. Relative durability factor of concrete containing superplasticizer greater than or equal to 80 percent ($\geq 80\%$) compared with reference.
 - i. Density (Unit weight) of concrete, ASTM C138.
 - j. Strength at 7 and 28 days, ASTM C39.
 - k. Certificate of analysis of coal fly ash or processed ultra-fine fly ash: Comply with ASTM C618, Class C or F and also the following requirements:
 - 1) Particle size (as determined by a laser diffraction particle size analyzer):
 - a) D-90 < 9.0 microns
 - b) D-50 < 3.5 microns
- F. Testing Agency: Promptly report all field concrete test results to Engineer, Contractor and Concrete Supplier. Include following information:
1. See Article "Quality Assurance."
 2. Density (unit weight) of concrete, ASTM C 138.
 3. Slump, ASTM C 143.
 4. Air content of freshly mixed concrete by pressure method, ASTM C 231 or volumetric method, ASTM C 173.
 5. Air content parameters of air-void system by microscopical determination, ASTM C 457.
 6. Concrete temperature at placement time. ASTM C 1064.
 7. Air temperature at placement time.
 8. Strength determined in accordance with ASTM C 39.
- G. Contractor: Submit grout temperature limitations with grout submittal.
- H. Submit current certification of welders.

- I. Submit shop drawings for steel reinforcement:
 - 1. Prepare placing drawings that detail fabrication, bending, and placement of concrete reinforcement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Comply with ACI SP-66, "ACI Detailing Manual."
- J. Submit laboratory test reports for concrete materials and mixtures.

1.5 CONTRACTOR'S PROFESSIONAL SERVICES - PERFORMANCE AND DESIGN CRITERIA

- A. Provide professional services for temporary conditions during construction and portions of the Work required to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Specific requirements and criteria include, but are not limited to the following:
 - 1. Design, erect, shore, brace, and maintain formwork, according to ACI 301 and ACI 347 to support vertical, lateral, static and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads. The contractor is responsible for layout and design, reviews, approvals, and inspections.
 - 2. Design formwork, shoring, bracing, and other conditions for structural requirements and stability during construction and until final structure is completed and accepted.
 - a. Comply with ACI 347.2 for design, installation, and removal of shoring and reshoring.
 - b. Superimposed loads to the concrete structure, slab-on-grade, and soil shall be less than the design loads as shown on Drawings.
 - c. Plan sequence of removal of shores and reshores to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excess stress or deflection.
- B. Design the "Nominal Form Width" for linear gap at time of forming or erecting concrete elements bounding the expansion joints in accordance with Drawings and Specification Section "Expansion Joint Assemblies".

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualification: An experienced supplier who is experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirement for production facilities and equipment. Manufacturer shall also be certified according to the National Ready Mixed Concrete Association's Certifications of Ready Mixed Concrete Production Facilities.
- C. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 301, "Specifications for Structural Concrete."

2. ACI 318, "Building Code Requirements for Structural Concrete and Commentary."
 3. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials."
 4. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
- D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in The State of North Carolina and who is experienced in providing professional engineering services of the kind indicated. See Article "Contractor's Professional Services Performance and Design Criteria".
- E. Materials and installed work may require retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.
- F. At least 35 days prior to scheduled start of concrete construction, contractor shall conduct meeting to review proposed mixture proportions and methods and procedures to achieve required concrete quality. Contractor shall send pre-concrete conference agenda to all attendees 20 days prior to scheduled date of conference indicating review requirements. Representatives of each entity directly concerned with cast-in-place concrete shall attend conference, including, but not limited to, the following:
1. Contractor's superintendent.
 2. Agency (laboratory) responsible for concrete mixture proportions.
 3. Agency (laboratory) responsible for field quality control.
 4. Ready-mixed concrete producer.
 5. Concrete subcontractor.
 6. Primary admixture manufacturers.
 7. Engineer or Owner's representative.
 8. At the pre-concrete meeting the contractor shall provide a summary of concrete procedures to protect fresh concrete from rain.
- The minutes shall include a statement by the Concrete Contractor indicating that the proposed mixture proportions and the placing/finishing/curing techniques can produce the concrete quality required by these specifications.
- G. Welders and welding procedures shall conform to requirements of AWS D1.4. Except where shown on Drawings, welding of reinforcing steel is prohibited unless accepted by Engineer in writing.
- H. Submit steel producer's certificates of mill analysis, tensile tests, and bend tests for reinforcing steel. Coordinate with welders and welding procedures.
- I. Inspection of steel reinforcement is required in accordance with IBC Section 110. Inspections shall be conducted by an inspection agency employed by Owner and approved by Engineer. Inspector shall provide report in approved format to Owner with copy to Engineer and Contractor. Inspection agency has authority to reject reinforcing not meeting Contract Documents. Inspections for all reinforcing steel for conformance to shop drawings and Contract Documents shall be completed prior to concrete placement.
- J. Submit following information on Inspection of Reinforcement unless modified in writing by Engineer:
1. Project name and location.
 2. Contractor's name.

3. Inspection Agency's name, address, and phone numbers (office and mobile).
 4. Date and time of inspection.
 5. Inspection Agency technician's name.
 6. Fabricator's name.
 7. Weather data:
 - a. Air Temperatures.
 - b. Weather.
 - c. Wind speed.
 8. Inspection location within structure.
 9. Reinforcement inspection data (including but not limited to):
 - a. Bar size, spacing, cover, and grade.
 - b. Splices, bends, anchorages, welding.
 - c. Support methods and construction sequencing.
 10. Diary of general progress of Work.
- K. Testing Agency Qualifications:
1. Independent agency, acceptable to authorities having jurisdiction, and acceptable to engineer, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 2. Testing laboratory shall submit documented proof of ability to perform required tests.
 3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 4 according to ACI CP-1 or an equivalent certification program.
- L. Testing Agency is responsible for conducting, monitoring and reporting results of all tests required under this Section. Testing Agency shall immediately report test results showing properties that do not conform to Project Specification requirements to General Contractor's authorized on-site representative and to Owner's authorized on-site representative.
- M. Submit following Field Test information for Project Concrete unless modified in writing by Engineer:
1. Project name and location.
 2. Contractor's name.
 3. Testing Agency's name, address, and phone number.
 4. Concrete supplier.
 5. Date of report.
 6. Testing Agency technician's name (sampling and testing).
 7. Placement location within structure.
 8. Time of batching.
 9. Time of testing.
 10. Elapsed time from batching at plant to discharge from truck at site.
 11. Concrete mixture data (quantity and type):
 - a. Cement.
 - b. Fine aggregates.
 - c. Coarse aggregates.
 - d. Water.
 - e. Air entraining admixtures.
 - f. Water-reducing admixture and high-range water-reducing admixture.
 - g. Other admixtures.

- h. Supplementary cementitious materials.
- 12. Weather data:
 - a. Air temperatures.
 - b. Weather.
 - c. Wind speed.
- 13. Field test data:
 - a. Date, time, and place of test.
 - b. Slump.
 - c. Concrete Temperature.
 - d. Air content.
 - e. Density (Unit weight).
- 14. Compressive test data:
 - a. Cylinder number.
 - b. Age of concrete when tested.
 - c. Date and time of cylinder test.
 - d. Curing time (field and lab).
 - e. Cross-sectional area of cylinder.
 - f. Compressive strength.
 - g. Type of failure (at break).
- N. All concrete flatwork finishers on Project shall hold current ACI Concrete Flatwork Finisher certification. Submit certification for each concrete flatwork finisher at Concrete Pre-construction Conference and obtain Engineer's written acceptance.
- O. Coal fly ash and processed ultra-fine fly ash supplier shall make available qualified individual, experienced in placement of fly ash concrete, to aid Contractor. Qualification of supplier's representative shall be acceptable to Owner. Representative shall attend pre-construction meeting, and shall be present for all trial placements, initial startup and then as required by Owner.
- P. At all times during high-evaporation conditions, maintain adequate supply of evaporation reducer at site. Do not use evaporation reducer as finishing aid. See Part 3.
- Q. Testing Agency: Identify those trucks of concrete supplier's which meet requirements of NRMCA Quality Control Manual. Permit only those trucks to deliver concrete to Project.

1.7 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO, "Standard Specifications for Highway Bridges."
- B. American Concrete Institute (ACI):
 - 1. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials."
 - 2. ACI 214R, "Evaluation of Strength Test Results of Concrete."

3. ACI 301, "Specifications for Structural Concrete."
4. ACI 302.1R, "Guide for Concrete Floor and Slab Construction."
5. ACI 305R, "Hot Weather Concreting."
6. ACI 306.1, "Cold Weather Concreting."
7. ACI 308R, "Guide to Curing Concrete."
8. ACI 308.1, "Standard Specifications for Curing Concrete."
9. ACI 318, "Building Code Requirements for Structural Concrete & Commentary."
10. ACI 347, "Guide to Formwork for Concrete."
11. ACI 362.1, "Guide for the Design of Durable Parking Structures."
12. ACI SP15, "Field Reference Manual."

C. American Iron and Steel Institute (AISI):

1. AISI, "Specification for the Design of Cold-Formed Steel Structural Members."

D. American Society for Testing and Materials (ASTM):

1. ASTM A 36, "Standard Specification for Carbon Structural Steel."
2. ASTM A 185, "Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement."
3. ASTM A 497, "Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete Reinforcement."
4. ASTM A 615, "Standard Specification for Deformed and Plain Carbon -Steel Bars for Concrete Reinforcement."
5. ASTM B 633, "Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel."
6. ASTM C 31, "Standard Practice for Making and Curing Concrete Test Specimens in the Field."
7. ASTM C 33, "Standard Specification for Concrete Aggregates."
8. ASTM C 39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens."
9. ASTM C 94, "Standard Specification for Ready-Mixed Concrete."
10. ASTM C 109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)."
11. ASTM C 138, "Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete."
12. ASTM C 143, "Standard Test Method for Slump of Hydraulic Cement Concrete."
13. ASTM C 150, "Standard Specification for Portland Cement."
14. ASTM C 157, "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete."
15. ASTM C 171, "Standard Specification for Sheet Materials for Curing Concrete."
16. ASTM C 172, "Standard Practice for Sampling Freshly Mixed Concrete."
17. ASTM C 173, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method."
18. ASTM C 231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method."
19. ASTM C 260, "Standard Specification for Air-Entraining Admixtures for Concrete."
20. ASTM C 309, "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete."
21. ASTM C 311, "Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete."
22. ASTM C 457, "Standard Test Method for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete."

23. ASTM C 494, "Standard Specifications for Chemical Admixtures for Concrete."
 24. ASTM C 618, "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete."
 25. ASTM C 666, "Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing."
 26. ASTM C 672, "Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals."
 27. ASTM C 989, "Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars."
 28. ASTM C 1064/C 1064M "Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete."
 29. ASTM C 1077, "Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation."
 30. ASTM C 1315, "Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete."
 31. ASTM C 1602/C 1602M, "Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete."
 32. ASTM E 96/E 96M, "Standard Test Methods for Water Vapor Transmission of Materials."
 33. ASTM E 1643, "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs."
 34. ASTM E 1745 "Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs."
 35. ASTM F1637 02, "Standard Practice for Safe Walking Surfaces."
- E. American Welding Society (AWS):
1. AWS D1.1, "Structural Welding Code-Steel."
 2. AWS D1.4, "Structural Welding Code-Reinforcing Steel."
- F. Concrete Reinforcing Steel Institute (CRSI):
1. CRSI MSP, "Manual of Standard Practice."
- G. US Army Corps of Engineers (CE):
1. CE CRD-C 513 "Specifications for Rubber Waterstops."
 2. CE CRD-C 572 "Specifications for Polyvinyl Chloride Waterstops."
- H. Prestressed Concrete Institute (PCI):
1. PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products."
 2. PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
 3. PCI MNL 120, "Design Handbook Precast Prestressed Concrete."
 4. PCI MNL 122, "Architectural Precast Design Handbook."
 5. PCI MNL 129, "Parking Structures-Recommended Practice for Design and Construction."
 6. PCI MNL 135, "Tolerances for Precast and Prestressed Concrete Construction."
 7. PCI "Code of Standard Practice for Precast Concrete."
- I. Contractor shall have following ACI publications at Project construction site:
1. ACI SP-15, "Field Reference Manual: Standard Specifications for Structural Concrete ACI

- 301 with selected ACI References.”
2. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
 3. ACI 305R, “Hot Weather Concreting.”
 4. ACI 306.1, “Cold Weather Concreting.”

J. Accessibility Requirements:

1. “Americans with Disabilities - Act Accessibility Guidelines for Buildings and Facilities”, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111, 1-800-872-2253, <http://www.access-board.gov/adaag/ADAAG.pdf>

K. International Code Council (ICC):

1. NCSBC, “North Carolina State Building Code 2012.”
2. IBC, “International Building Code 2009.”
3. IFC, “International Fire Code.”

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store all formwork and formwork materials clear of ground, protected, to preclude damage.
- B. Deliver reinforcement to Project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- C. Store concrete reinforcement materials at site to prevent damage and accumulation of dirt or excessive rust.
- D. Concrete transported by truck mixer or agitator shall be completely discharged within one and one half-hours (one hour for hot weather concreting) after water has been added to cement or cement has been added to aggregates. For concrete with processed ultra-fine fly ash, concrete shall be completely discharged within one hour after water has been added to cement or cement has been added to aggregates, in all weather conditions, hot or cold. Schedule deliveries to allow for delays due to weather, traffic, etc.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. Structural 1, B-B or better; mill oiled and edge sealed.
 - b. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Form Coatings: Provide commercial formulation form-coating compounds with a maximum VOC of 350 grams/liter that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces, including but not limited to water-curing, stains, or paints.
- D. Form Ties: Factory - fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1.5 in. to exposed surface.
 - 1. Provide ties that, when removed, will leave holes not larger than 1 in. diameter in concrete surface.
- E. Chamfer strips: Wood, metal, PVC, or rubber strips. 0.75 in. by 0.75 in. min. unless noted otherwise.

2.2 STEEL REINFORCEMENT

- A. Reinforcement Bars: ASTM A 615, deformed, yield strength: as noted on Drawings.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from all plastic of greater compressive strength than concrete, and as follows:
 - 1. For concrete surfaces exposed to view where bar supports contact forms, supports shall have minimal contact, shall not cause voids and shall not cause damage to surrounding concrete. Use all-plastic supports conforming to CRSI Class 1 protection requirements.
 - 2. Chairs shall be sized and spaced to prevent cover loss during construction operations.
 - 3. Acceptable manufacturers:
 - a. Aztec Concrete Accessories, Inc.
 - b. General Technologies, Inc.
 - c. Accepted equivalent.
 - 4. For welded wire reinforcement, provide continuous bar supports spaced at 2 feet on center, maximum."
- B. For mechanical tension splices of reinforcement:
 - 1. All splices to develop 125 percent of specified yield strength of bars, or of smaller bar in transition splices. Acceptable products:
 - a. Bar-Lock Rebar Coupler, by Dayton Superior.
 - b. Bar-Grip or Grip-Twist, by Barsplice Products, Inc.
 - c. Extender HRC 500 Series Coupler, by Headed Reinforcement Corp.
 - d. Splice Sleeve, by NMB.
 - e. LENTON Splices, by Erico.

- C. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.

2.4 CONCRETE MATERIALS

- A. Ready Mixed Concrete: Obtain concrete from plant with current certification from:

1. Concrete Materials Engineering Council.
2. The State of North Carolina Department of Transportation.
3. National Ready Mixed Concrete Association.
4. Prestressed Concrete Institute.

- B. Portland Cement (ACI 301, Section 4 header "Cementitious Materials"):

1. Portland cement, Type I, ASTM C 150. Use one cement supplier throughout project. No change in brand or supplier without prior written acceptance from Engineer.
2. Blended cement, ASTM C 595, Type IP only with prior written acceptance from Engineer.

- C. Coal Fly Ash:

1. Permitted in footings, columns, and walls, only.
2. ASTM C 618, Class C or F.
3. Testing: ASTM C311.
4. Percentage of fly ash in Mixture Proportion shall be by weight, not by volume. Water/cement ratio will be calculated as water/cementitious (total cement and fly ash) ratio.
5. Prohibited: Fly ash in same mix with Type IP blended cement.
6. If strength or air content varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.
7. Submit all fly ash concrete Mixture Proportions per ACI 301.

- D. Slag – (Ground Granulated Blast-Furnace Slag – GG-BFS):

1. ASTM C 989, Grade 100 or higher.
2. Percentage of GGBF slag in Mixture Proportion shall be by weight, not by volume. Water-cement ratio shall be calculated as water-cementitious (total Portland cement + GGBF slag) ratio.
3. If strength or air content varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.
4. Submit all GGBF slag concrete mixture proportions per ACI 301.

- E. Normal Weight Aggregates (ACI 301, Section 4 header "Aggregates"):

1. Normal weight concrete aggregates:
 - a. Coarse aggregate: Crushed and graded limestone or approved equivalent conforming to ASTM C33 except as noted here, minimum class designations as listed below:
 - 1) Below grade construction and below frost line: Class 1S.
 - 2) Walls not exposed to public view: Class 3S.
 - 3) Walls exposed to public view: Class 5S.
 - 4) Toppings and washes: Class 5S.
 - 5) Slabs on ground: Class 4S.
 - 6) All other concrete: Class 5S.

- b. No deleterious materials such as, but not limited to, chert or opaline.
 - c. Fine aggregate: Natural sand conforming to ASTM C 33 and having preferred grading shown for normal weight aggregate in ACI 302.1R, Table 5.1.
 - d. Coarse Aggregate shall not contain crushed hydraulic-cement concrete.
- 2. Coarse aggregate: Nominal maximum sizes indicated below, conforming to ASTM C 33, Table 2:
 - a. Footings/Foundations: Size number 57 or 357.
 - b. Toppings and washes less than 3 in. thick: Size number 7 or 67.
 - c. Slab on grade: Size number 57.
 - d. All other members: Size number 67.
- 3. Chloride Ion Level: ASTM C 1218. Chloride ion content of cement, aggregates and all other ingredients: Tested by laboratory making trial mixes.
- F. Water: Comply with ASTM C 1602.
- G. Storage of Materials (ACI 301, Section 4 header "Materials Storage and Handling").

2.5 ADMIXTURES

- A. Use water-reducing admixture, mid-range water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete as required for placement and workability.
- B. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg. F as required for schedule.
- C. Use high-range water-reducing admixture (HRWR) in pumped concrete, and for concrete with water/cementitious ratio of less than or equal to 0.45. Use high-range or mid-range water-reducing admixtures in pumped concrete and normal or mid-range water reducing admixtures for concrete with water/cementitious ratios greater than 0.45.
- D. Self-consolidating concrete (SCC) may be used where placement due to either dense reinforcement or form design requires both a high level of workability (horizontal slump flow greater than 24 in. diameter) and the water/cementitious ratio is less than or equal to 0.45.
- E. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1.5 percent within limits shown on Drawings.
- F. Only admixture manufacturers listed acceptable. Do not submit alternate manufacturers.
- G. Concrete supplier and manufacturer shall verify via trial mixes and certify compatibility (no adverse effect on workability, strength, durability, entrained air content, etc.) of all ingredients in each Mixture. Use admixtures in strict accordance with manufacturer's recommendations.
- H. Prohibited Admixtures: Calcium chloride or admixtures containing intentionally added chlorides shall not be used.

- I. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Air-Mix," "Eucon Air-Series" or "AEA-92," Euclid Chemical Co.
 - b. "Daravair Series" or "Darex Series," W.R. Grace & Co.
 - c. "Micro-Air," or "MB-VR," or "MBAE-90," BASF Construction Chemicals.
 - d. "Sika AEA Series," or "Sika AIR Series," Sika Corporation.
- J. Normal Water-Reducing Admixture: ASTM C 494, Type A.
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon Series," Euclid Chemical Co.
 - b. "WRDA Series," W.R. Grace & Co.
 - c. "Pozzolith Series," or "PolyHeed Series," BASF Construction Chemicals.
 - d. "Plastocrete Series", Sika Corporation.
- K. Mid-Range Water-Reducing Admixture: ASTM C 494, Type A.
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon MR" or "Eucon X-15 and X-20," Euclid Chemical Co.
 - b. "Daracem Series" or "MIRA Series," W.R. Grace & Co.
 - c. "PolyHeed Series," BASF Construction Chemicals.
 - d. "Sikaplast Series" or "Plastocrete Series", Sika Corporation.
 - e. "Polychem 1000" or "KB Series," General Resource Technology.
 - f. "Finishease-NC," Russ Tech Admixtures, Inc.
 - g. "OptiFlo Series" or "EcoFlo Series," Premiere Concrete Admixtures.
- L. High Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F.
 - 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon 37" or "Plastol Series," Euclid Chemical Co.
 - b. "Daracem Series" or "ADVA Series," W.R. Grace & Co.
 - c. "Rheobuild 1000", "PS 1466" or "Glenium Series," BASF Construction Chemicals.
 - d. "Sikament Series" or "Sika ViscoCrete Series," Sika Corporation.
 - e. "Melchem Series," General Resource Technology.
 - f. "Superflo 443" or "Superflo 2000 Series," Russ Tech Admixtures, Inc.
 - g. "EcoFlo Series" or "UltraFlo Series," Premiere Concrete Admixtures.
- M. High-Range Water-Reducing Admixture (Superplasticizer) for Self-Consolidating Concrete, ASTM C 494 Type F.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Plastol Series" or "Eucon SPJ," Euclid Chemical Co.
 - b. "ADVA Series," GCP Applied Technologies.
 - c. "Glenium Series" or "PS1466," BASF Construction Chemicals.
 - d. "Sika ViscoCrete Series" or "Sikament Series", Sika Corporation.
- N. Viscosity Modifying Admixture for Self-Consolidating Concrete:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Visctrol" or "Eucon ABS," Euclid Chemical Co.
 - b. "Rheomac VMA Series," BASF Construction Chemicals.
 - c. "Sika Stabilizer Series," Sika Corporation.
- O. High Range Water-Reducing Retarding Admixture (superplasticizer): ASTM C 494 Type G.
 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon 537 or RD2," Euclid Chemical Co.
 - b. "Daracem 100," W.R. Grace & Co.
 - c. "Sikament Series," Sika Corporation.
- P. Non-Chloride, Non-Corrosive Water-Reducing, Accelerating Admixture: ASTM C 494, Type C or E.
 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon AcN-Series," "Accelguard 80," "Accelguard NCA," or "Accelguard 90," Euclid Chemical Co.
 - b. "DCI," "PolaraSet," "Lubricon NCA," "Daraset," or "Gilco," W.R. Grace & Co.
 - c. "Pozzutec 20+" or "Pozzolith NC 534," BASF Construction Chemicals.
 - d. "Sika Set NC," "Plastocrete 161FL," or "Sika Rapid-1," Sika Corporation.
- Q. Water-Reducing or Retarding Admixture: ASTM C 494, Type D or B.
 1. Products: Subject to compliance with requirements, provide one of following:
 - a. "Eucon Retarder-75," "Eucon DS" or "Eucon W.O." Euclid Chemical Co.
 - b. "Daratard-17" or "Recover," W.R. Grace & Co.
 - c. "Pozzolith Series" or "Delvo Series," BASF Construction Chemicals.
 - d. "Sikatard Series," or "Plastiment Series" or "Plastocrete Series," Sika Corporation.

2.6 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Prefabricate corners, intersections, and directional changes at factory.
 1. Profile: As indicated.
- B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Prefabricate corners, intersections, and directional changes at factory.
 1. Profile: As indicated.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Rubber Waterstops:
 - a. Sika Corporation.
 - b. Progress Unlimited Inc.
 - c. Williams Products, Inc.

2. PVC Waterstops:

- a. Sika Corporation.
- b. Meadows: W.R. Meadows, Inc.
- c. Progress Unlimited Inc.
- d. Sternson Group.

D. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Superstop; Tremco Inc.
- b. Volclay Waterstop-RX; Colloid Environmental Technologies Co.
- c. Mirastop; Miradri, Div. Of Royal Ten Cate (USA), Inc.
- d. Superstop; Progress Unlimited Inc.
- e. Hydrotite or SikaSwell Profile; Sika Corporation.

2.7 VAPOR BARRIERS

A. Vapor Barrier: Provide vapor barrier which conforms to ASTM E 1745, Class A. The membrane shall have a water-vapor transmission rate less than or equal to 0.008 gr. /ft²/hr. when tested, in accordance with ASTM E96. Vapor barrier shall be no less than 15 mils thick. The vapor barrier shall be placed over prepared base material where indicated below slabs on ground.

1. New ISO certified virgin resins, polyolefin based maximum.
2. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to "Griffolyn Vaporguard" by Reef Industries, Inc., Stego Wrap (15-Mil) Vapor Barrier by Stego Industries LLC, or Perminator (15 Mil) Underground Vapor Barrier by W.R. Meadows.

2.8 CURING MATERIALS

A. Evaporation Reducer: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Evaporation Retarder:

- a. Aquafilm, Conspec Marketing & Manufacturing Co., Inc.
- b. Eucobar, Euclid Chemical Co.
- c. E-Con, L&M Construction Chemicals, Inc.
- d. MasterKure ER 50, BASF Construction Chemicals.
- e. SikaFilm, Sika Corporation.
- f. Sure-Film (J-74), Dayton Superior Corporation.
- g. "EVRT", Russ Tech Admixtures, Inc.
- h. "Barrier", Premiere Concrete Solutions.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

- D. Water: Potable.
- E. Curing Compound: Prohibited.

2.9 RELATED MATERIALS

- A. Bonding Additive: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
 - 2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- C. Post Installed mechanical and adhesive anchors shall be manufactured by Hilti Fastening Systems, Tulsa Oklahoma, ITW Ramset/Red Head, Wood Dale, IL, Simpson Anchor Systems, Columbus, OH, Powers Fasteners, Brewster, NY, or accepted equivalent. Anchor bolt composition shall be from one or more of carbon steel and stainless steel, lead, Zamac alloy, nylon, plastic, polypropylene, and jute fiber.
 - 1. Strength of anchors shall comply with ACI 318-11 Appendix D, and ACI 355.2 and ICC-ES-AC193 for mechanical anchors and ACI 355.4 and ICC-ES-AC308 for adhesive anchors.
 - 2. Carbon steel anchors shall be either zinc plated in accordance with ASTM B 633, or hot-dipped galvanized in accordance with ASTM A-153-78. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
 - 3. Stainless steel anchors shall be manufactured from ASTM A304, or A663 stainless steel. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
 - 4. Plastic, lead, or Zamac alloy anchors shall not be used for overhead applications. Adhesive anchors shall not be used to resist pullout forces in overhead and wall installations unless proper consideration is given to fire conditions. For adhesive anchors, consult with manufacturer's engineer.
 - 5. Safety Factors: Static loads 4:1 minimum. Static load safety factors shall be per manufacturer's published data. Critical load (vibratory, overhead, etc. or more) safety factors shall be 10:1 minimum. Adhesive anchors are not permitted for critical loads and where resistance to direct sustained tension is required.
 - a. If necessary for purposes of determining tensile and/or shear capacity in questionable base material, testing shall be done prior to actual anchor installation. A maximum of five tension and/or shear tests shall be performed by manufacturer's engineer. Anchors shall be proof loaded in tension and/or shear to assure that working load capacity is within specified allowable load limit as published by manufacturer.
 - 6. Anchor spacing and edge distance per manufacturer's limits. Loading and cluster spacing shall be as established by minimum industry standards for anchors, except as follows: Anchor loading, cluster spacing and edge distances shall be as published in manufacturer's literature. Consult with manufacturer's engineer for specific requirements.
 - 7. Anchor installation shall be as required by manufacturers printed installation instructions.

D. Inserts and Coil Rods:

1. Yield strength: 65,000 psi minimum.
2. Galvanizing: Where indicated, electrodeposited zinc coating, ASTM B 633, Service condition 1, Type III.
3. Acceptable manufacturers:
 - a. Dayton/Richmond Concrete Accessories, Inc., Miamisburg, OH.
4. Details shown on drawings are based on Dayton/Richmond Concrete Accessories, Inc. products and their respective capacities. Other products may be used only if contractor submits calculations, sealed by professional engineer or structural engineer licensed in The State of North Carolina, substantiating strength of connection with other product. Calculations are subject to Engineer's acceptance before fabrication is to proceed.

E. Joint Filler:

1. Joint filler in slabs and curbs: Asphalt impregnated fiber board; as shown on Drawings. Acceptable products:
 - a. "Flexcell," Knight-Celotex Corp.
 - b. "Fibre Expansion Joint," W.R. Meadows, Inc.
2. Joint filler used vertically to isolate walls from columns or other walls: White molded polystyrene beadboard type.
3. Joint cover used to bridge gap between columns and grade walls, retaining walls, or basement walls: Minimum width: Gap width plus 4 in. For gaps over 3 in. wide, protect cover with protection board sized to span gap satisfactorily. Acceptable products:
 - a. "Sealtight Premoulded Membrane Vapor Seal," W.R. Meadows, Inc., Elgin, Illinois.
 - b. "Sealtight Melgard," W.R. Meadows, Inc., Elgin, Illinois and shall be applied according to manufacturer's instructions.

2.10 REPAIR MATERIALS

A. Acceptable repair materials:

1. Extended Open Time Epoxy Bonding Agent: Three-component, water based, epoxy modified Portland cement bonding agent and corrosion inhibitor coating providing the recommended Manufacturer's open time in which to apply repair mortar. Product shall be capable of achieving bond strength of 2,700 psi per ASTM C 882.
 - a. "Duralprep A.C.", by The Euclid Chemical Company, Cleveland, OH.
 - b. "MasterEmaco P 124," by BASF Construction Chemicals, Shakopee, MN.
 - c. "Sika Armatec 110 EpoCem", by Sika Corporation, Lyndhurst, NJ.
 - d. "Planibond 3-C" or "Mapefer 1K", by Mapei Corporation, Deerfield Beach, FL.
2. Epoxy Adhesive: 2 or 3 component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces:
 - a. "Euco #452 Epoxy Series" or "Dural Series," by The Euclid Chemical Company, Cleveland, OH.
 - b. "MasterEmaco P 124," or "MasterEmaco ADH 326," by BASF Construction Chemicals, Shakopee, MN.

- c. "Sikadur 32 Hi-Mod LPL" by Sika Corporation, Lyndhurst, NJ.
3. Trowel Applied Repair Mortar: Shall be prepackaged polymer-modified cementitious repair mortar capable of vertical/overhead application by trowel achieving a minimum 3,000 psi compressive strength at 7 days and 5,000 psi compressive strength at 28 days per ASTM C 109 as certified by manufacturer. All patches shall be square or rectangular in shape with ½" deep sawcut edges, except at locations of reinforcement or tendons. Minimum repair thickness shall be ½" unless specified greater by the manufacturer and maximum lift thickness according to manufacturer requirements.
- a. "MasterEmaco N 300 CI," "MasterEmaco T 310 CI," "MasterEmaco N 350 CI," "MasterEmaco N 427," "MasterEmaco N 426," "MasterEmaco N 400 RS or MasterEmaco N 400," by BASF Construction Chemicals, Shakopee, MN.
 - b. "Duraltop Gel", "Speedcrete PM", or "Verticoat", by The Euclid Chemical Company, Cleveland, OH.
 - c. "SikaRepair 223 with Latex R", "SikaRepair SHB with Latex R", or SikaRepair SHA with Latex R", by Sika Corporation, Lyndhurst, NJ.
 - d. "Planitop 23" by MAPEI Corporation, Deerfield, FL.
4. Horizontal Repair Mortar: Shall be prepackaged polymer-modified, cementitious repair mortar capable of horizontal, pour and screed, form and pour, partial depth, partial and full depth, or full depth applications. Material shall achieve a minimum 3,000 psi compressive strength at 7 days and 5,000 psi compressive strength at 28 days per ASTM C109 if neat and ASTM C39 if extended as certified by manufacturer. Manufacturer shall submit volume and size of SSD aggregate used for mix extension. All patches shall be square or rectangular in shape with ½" deep saw cut edges, except at locations of reinforcement or tendons. Minimum thickness shall be ½" and maximum thickness of placement according to manufacturer requirements.
- a. "Duraltop Flowable Mortar", by The Euclid Chemical Company, Cleveland, OH.
 - b. "MasterEmaco S 466 CI," or "MasterEmaco T 310 CI," by BASF Construction Chemicals, Shakopee, MN.
 - c. "SikaTop 111 Plus", "Sikatop 122 Plus", or Sika Repair 222 with Latex R", by Sika Corporation, Lyndhurst, NJ.
 - d. "LS-S6 or S10" or "LM-S6 or S10", by King Packaged Materials Company, Burlington, ON.
 - e. "Topcem Premix with Planitop AC", by MAPEI Corporation, Deerfield Beach, FL.
5. Immediate upon conclusion of finishing operation, cure concrete in accordance with ACI 308 for duration of at least seven days by moisture curing or moisture retaining covering. Provide additional wet curing immediately following initial curing and as necessary before concrete has dried.
- a. Continue method used in initial curing.
 - b. Material conforming to ASTM C171.
 - c. Other moisture retaining covering as approved by Engineer.
 - d. During initial and final curing periods maintain concrete above 50°.
 - e. Prevent rapid drying at end of curing period.

2.11 CONCRETE MIXTURES

- A. Proportion mixtures determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
 2. Provide different mixtures as the season warrants, as well as each type and strength of concrete or for different placing methods.
- B. Use a qualified independent testing agency for preparing and reporting proposed Mixture Proportions for the laboratory trial mix basis.
- C. Requirements for normal-weight concrete mix are shown on Drawings:
1. Compressive strength
 2. Slump
 3. Water-cementitious materials ratio
 4. Air content
- D. Air Entrainment:
1. See General Notes on Drawings for total average air content (percent by volume).
 2. Average air content shall exceed value stated in General Notes on Drawings.
 3. Permissible variation for any one test result from specified average total air content: Plus or minus 1.5 percent.
 4. Hardened concrete shall have an air void spacing factor of 0.0080 in. maximum. Specific surface (surface area of air voids) shall be 600 in² per cu in. of air-void volume, or greater. Concrete mixes not meeting these values as determined by ASTM C 457 may require adjustments unless accepted in writing by Engineer. Refer to Part 1 Article "Submittals."
 5. Consider using water-reducing admixture or high-range water-reducing admixture (Superplasticizers), OR admixtures that achieve self-consolidating concrete, as required, for placement, workability, finishing and when required, increased flowability.
 6. Consider using water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 7. Use high range water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with a water-cementitious materials ratio of 0.45 or less. Use normal or mid-range water reducing admixture for concrete with water-cementitious materials ratio greater than 0.45.
- E. Slump (ACI 301, Part 4 header "Slump"):
1. Maximum slump for concrete is indicated on Drawings. Where field conditions require slump to exceed that shown, increased slump shall be obtained by use of high range water reducers (superplasticizers) only, and Contractor shall obtain written acceptance from Engineer who may require an adjustment to mix.
 2. All concrete containing high-range water-reducing admixture (superplasticizer) shall have a verified initial slump of 2–3 in. Final slump after the addition of the superplasticizer shall be 6–9 in. as required by the contractor to properly place the concrete. Before permission for plant addition of superplasticizer to be granted by Engineer, fulfill following requirements:
 - a. Submit letter from testing laboratory which developed original mixture proportions, for each superplasticized mixture, certifying volume of mix water which will produce specified slump and water/cement ratio, taking into account aggregate moisture content.
 - b. Submit plant computer printout of mixture ingredients for each truckload of superplasticized concrete with delivery of that truckload. Mix water volume greater than that certified shall be cause for concrete rejection.
 - c. Over-retarding or crusting of flatwork surface is a cause for concrete rejection.

- d. Segregation or rapid slump loss (superplasticizer life) due to incompatibility or under-dosing is a cause for concrete rejection.

F. Self-Consolidating Concrete:

- 1. Minimum flow of 24 in. to 28 in. or as required by the successful test placement. All self-consolidating concrete shall contain the specified high-range water-reducing admixture and viscosity-modifying admixture as required.
- 2. Measure slump flow using slump cone upright or inverted in accordance with ASTM C1611. Measured flow shall be greater than 24 inches and consistent with submitted mixture test parameters plus or minus 2 in.
- 3. Measure passing ability in accordance with ASTM C 1621/C 1621M. Use the slump cone in the same way as in the slump flow test. Difference in average slump flow between slump flow and passing ability tests shall not exceed 2 in.
- 4. Determine the static segregation (stability) in accordance with ASTM C 1610/C 1610M. Segregation factor of the mixture shall not be more than 15 percent.

- G. Engineer's acceptance of mixture proportions shall not relieve Contractor from responsibility for any variation from requirements of Contract Documents unless Contractor has in writing called Engineer's attention to each such variation at time of submission and Engineer has given written approval of each such variation.

- H. Adjustment to Concrete Mixtures: Adjustments to mixture proportions may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mixture and strength results shall be submitted to and accepted by Engineer before using in work.

2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information. Truck mixing prohibited. Mix at plant.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Provide plant-printed batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mixture identification number, date, time of batching, mixing time, quantity and details of materials, amount of water introduced, and water permitted by plant to be added, if any.

2.13 TOOLS

- A. Slab Jointing
 - 1. Concrete groovers: For tooled joints in concrete:
 - a. For concrete not exceeding 4 in. thickness, use groover with 1 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.
 - b. For concrete exceeding 4 in. thickness, use groover with 1.5 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads and in accordance with Article 1.5 "Contractor's Professional Services – Performance and Design Criteria".
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117, except as modified below:
 - 1. Footings:
 - a. Footings other than those to receive masonry construction: Variation of bearing surface from specified elevation: Plus or minus 0.5 in.
 - b. Footings to Receive Masonry Construction:
 - 1) Variation of center from specified location in plan: Plus or minus 0.25 in. in any 10 ft., but not to exceed plus or minus 0.5 in.
 - 2) Variation of bearing surfaces for specified elevation: Plus or minus 0.25 in. in any 10 ft., but not to exceed plus or minus 0.5 in.
 - 2. Piers, Columns, Walls, Beams, and Slabs:
 - a. Variation in cross-sectional dimensions of piers, beams and columns and in thickness of walls and slabs: 12 in. or less: Plus 0.375 in., minus 0.25 in. Greater than 12 in.: Plus 0.5 in., minus 0.375 in.
 - b. Variation in elevation from specified elevation for piers, columns and walls: Plus or minus 0.5 in.
 - 3. Anchor bolts: Concrete Contractor shall place anchor bolts within tolerances stated under heading "Anchor Bolts and Bearing Plates" of PCI "Code of Standard Practice for Precast Concrete."
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, Reglets, recesses, and the like, for easy removal.
 - 2. Kerf wood inserts for easy removal.
 - 3. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sink ages, keyways, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, provided concrete is hard enough to not be damaged by form-removal, and provided curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR BARRIER

- A. Vapor Barrier: Place, protect, and repair vapor-barrier or vapor sheets according to ASTM E 1643 and manufacturer's written instructions.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier before placing concrete.

- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain specified concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on continuous bar supports spaced at 2 feet on center, maximum. Lap edges and ends of adjoining sheets per ACI 318 and as follows:
 - 1. Length of overlap measured between outermost cross wires of each sheet shall not be less than one spacing of cross wires plus two inches nor less than one and one-half times the development length nor 6 in. minimum where development length is calculated per section 12.8 of ACI 318.
 - 2. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
- F. Splices:
 - 1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.
 - 2. For mechanical tension splices of reinforcement:
 - a. Exercise care to assure that no reduction of cross-sectional area of reinforcement occurs.
 - b. For all mechanical splices, perform splicing in strict accordance with manufacturer's requirements and instructions.
 - c. Stagger splices in adjacent bars.
 - d. Except where shown on Drawings, welding of reinforcement prohibited without prior written authorization by Engineer.
 - 3. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.
 - 4. Welded wire reinforcement shall not extend through contraction joints.

3.6 JOINTS

- A. Joints in Concrete (ACI 301, Section 5):
 - 1. Construction, control and isolation joints are located and detailed on Drawings:
 - a. Tool joints at time of finishing. Tool: Part 2 Article "Tools."
 - b. Isolation joints: Interrupt structural continuity resulting from bond, reinforcement or keyway.
 - c. Coordinate configuration of tooled joints with control joint sealants.
- B. Use bonding grout, containing the specified bonding admixture, on existing concrete surfaces that will be joined with fresh concrete.
- C. Joint sealant material is specified in Division 7 Sections.

3.7 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Engineer/Architect.
- C. Do not add water to concrete after adding high-range water-reducing admixtures to mix.
- D. Check air content after any site addition of admixtures to increase slump.
- E. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- F. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 - 1. Consolidate placed concrete with mechanical vibrating equipment.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically (in thin slabs vibrator may be inserted at angle or horizontally to keep vibrator head completely immersed) inserted at uniformly spaced locations no farther than 1.5 times action radius so area visibly affected by vibrator overlaps adjacent previously vibrated area by 3-4 inches. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration (usually 5 to 15 seconds) of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- G. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge or motor driven vibrating screed and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using highway bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- H. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Use only the specified non-corrosive accelerator. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mixture proportions.
- I. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
- J. Precast concrete receiving cast-in-place concrete (topping, landing, etc.) shall be saturated dry prior to placement of the cast-in-place concrete.

3.9 FINISHING FORMED SURFACES

- A. As-Cast Finishes: As-cast concrete texture imparted by form-facing material in accordance with ACI 301 and as specified below in accordance with Class of Finish:
1. Rough Form Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding limits for class of surface specified.
 - a. Provide class C finish as described in ACI 347, for surfaces permanently concealed from public view, unless otherwise noted in the Contract Documents. Class C permits gradual or abrupt irregularities of 1/2 inch.
 2. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding limits for class of surface specified.
 - a. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing,

- dampproofing, veneer plaster, or painting.
 - b. Provide Class A finish as described in ACI 347. Class A permits gradual or abrupt irregularities of 1/8 inch.
- B. Rubbed Finish: Apply the following to smooth-formed finished concrete:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
- D. Architectural Finishes: Produce architectural finishes including special textured finishes, and exposed aggregate finish in Accordance with ACI 301 section 6.
 - 1. Provide Class A finish as described in ACI 347 for Architectural finishes. Class A permits gradual or abrupt irregularities of 1/8 inch.
 - 2. Special Finishes: Rubbed finish where indicated on Architectural drawings.

3.10 FINISHING FLOORS AND SLABS

- A. Flatwork in Parking and Drive Areas (BROOM Finish, ACI 301, Section 5 header "Broom or Belt Finish":
 - 1. Bullfloat immediately after screeding. Complete before any excess moisture or bleed water is present on surface (ACI 302.1R, Article 8.3.3). The use of power trowels is not allowed.
 - 2. After excess moisture or bleed water has disappeared and concrete has stiffened sufficiently to allow operation, give slab surfaces coarse transverse scored texture by drawing broom across surface. Texture shall be as accepted by Engineer from sample panels.
 - 3. Finish tolerance: ACI 301, Paragraph 5.3.4.2 and ACI 117, paragraph 4.8.6: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 0.75 in. from elevation noted on Drawings anywhere on floor surface.
 - 4. Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear cost of any corrections to provide for positive drainage.
- B. Flatwork in Stair Towers and Parking Garage floor subject to pedestrian traffic:
 - 1. Concrete surfaces at all walking areas subject to pedestrian traffic shall provide a smooth, slip resistant walking surface for pedestrians with these minimum requirements:
 - a. Shall provide walking surfaces in accordance with ASTM – F 1637 Standard Practice for Safe Walking Surfaces and "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1.
 - b. Adjoining walkway surfaces shall be flush and meet the following minimum

requirements:

- 1) Changes in level of less than 1/4 inch in height may be without edge treatment as shown in ADA Figure 303.2 and on the Drawings.
 - 2) Changes in Level between 1/4 inch and 1/2 inch in height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3 and on the Drawings.
 - 3) Changes in level greater than 1/2 inch in height are not permitted unless they can be transitioned by means of a ramp with minimum requirements shown on the Drawings.
 - 4) Openings in floor or ground surfaces shall not allow passage of a sphere more than 1/2 inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3 and on the Drawings.
- c. Walkway surfaces shall provide a slip resistant surface.
- 1) Concrete surfaces shall be troweled and finished to provide a slip resistant finish.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still workable and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.12 CONCRETE PROTECTION AND CURING

- A. General: Comply with ACI 308.1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Reducer: Apply evaporation reducer to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb. /sq. ft. /h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing. Do not finish immediately after evaporation reducer applied. Wait until after (green, if Confilm used – pink, if Eucobar used) film disappears.
- C. Formed Surfaces: Cure formed concrete surfaces including the underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Tepid (within 20 deg F of concrete temperature) water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. Curing Compound: Prohibited.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Tepid (within 20 deg F of concrete temperature) water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
 3. Curing Compound: Prohibited.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer/Architect. Remove and replace concrete that cannot be repaired and patched to Engineer/Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one-part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing. Use this repair procedure only with Engineer/Architect approval.

- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with specified bonding agent. Fill and compact with specified patching mortar before specified bonding agent has dried. Fill form-tie voids with specified patching mortar or cone plugs secured in place with specified bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area on mockup, or if none, at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer/Architect.
 4. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with procedures and materials specified in Division 7 Sections "Water Repellents" and "Concrete Joint Sealants." Receive Engineer's written acceptance of methods and materials selected prior to application.
 - a. Repair isolated random horizontal cracks less than 0.01 in. wide, using silane sealer product specified in Division 7 "Water Repellents."
 - b. Repair isolated random horizontal cracks and torsion cracks 0.01 in. to less than 0.03 in. wide, using Methymethacrylate or Sikadur 55 SLV product specified in Division 7 "Water Repellents."
 - c. Repair isolated random horizontal cracks 0.03 in. to 0.06 in. wide: route and seal with specified sealant product in Division 7 "Concrete Joint Sealants."
 - d. Repair isolated random vertical cracks more than 0.01 inch wide, using epoxy injection product specified in Part 2 heading "Related Materials" of this section.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, pop-outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete or latex modified concrete as approved by the Engineer. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact,

and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

6. Repair single holes 1 inch or less in diameter with patching mortar. Cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
7. Repair isolated random cracks that have little movement and single holes not over 1 inch in diameter in accordance with procedures and materials specified in Division 7 Section "Concrete Joint Sealants." Receive Engineer's written acceptance of methods and materials selected prior to application.
 - a. Repair isolated random horizontal cracks less than 0.01 inch wide, using silane sealer product specified in Division 7 "Water Repellents."
 - b. Repair isolated random horizontal cracks and torsion cracks 0.01 inch to less than 0.03 inch wide, using Methylmethacrylate or Sikadur 55 SLV product specified in Division 7 "Water Repellents."
 - c. Repair isolated random horizontal cracks 0.03 inch to 0.06 inch wide: route and seal with specified sealant product in Division 7 "Concrete Joint Sealants."
 - d. Repair isolated random vertical cracks more than 0.01 inch wide, using epoxy injection product specified in Part 2 heading "Related Materials" of this section.
- E. Perform structural repairs of concrete, subject to Engineer/Architect's approval, using epoxy adhesive and patching mortar, latex modified concrete or other materials as approved by the Engineer.
- F. Repair materials and installation not specified above may be used, subject to Engineer/Architect's approval.

3.14 FIELD QUALITY CONTROL

- A. Owner will employ a testing laboratory to perform tests and to submit test reports.
- B. Sample concrete in accordance with ASTM C 172.
- C. Temperature:
 1. Test temperature of concrete in accordance with ASTM C 1064/C 1064M and ACI 301 each time cylinders are taken or as directed by the Engineer.
- D. Slump Test:
 1. Conduct one slump test in accordance with ASTM C 143/C 143M per truck load of ready-mixed concrete delivered to Project at truck for superstructure concrete.
 2. Conduct slump test in accordance with ASTM C 143/C 143M and ACI 301 for foundation concrete.
 3. When high-range water-reducing admixture (superplasticizer) is used, initial slump must be verified by Testing Agency.
- E. Air Content:
 1. General Contractor: Coordinate all parties involved to produce conforming concrete.

2. Sample freshly-mixed concrete at point of final placement in accordance with ASTM C 172 and conduct one air content test in accordance with ASTM C 231 or ASTM C 173 for each truck of ready-mix, air entrained concrete delivered to Project.
3. Sample fresh concrete immediately following placement and screeding and conduct air content tests in accordance with ASTM C 231 or ASTM C 173 at rate of one for every 10 truckloads of ready-mix, air-entrained concrete delivered to Project. For small or half-loads, obtain Engineer's acceptance of procedure 2 weeks before situation arises.

F. Concrete Compressive Strength:

1. Make test cylinders in accordance with ASTM C 31 and test in accordance with ASTM C 39 as follows:
 - a. Take minimum of three sets of cylinders for each 100 cu yds. or fraction thereof, of each Mixture of concrete placed in any one day.
 - b. A set of cylinders shall be comprised of two 6 inch by 12 inch cylinders or three 4 inch by 8 inch cylinders.
 - c. At Contractor's option and cost, cylinders may be taken to verify concrete strength prior to form removal.
 - d. Testing Agency: Provide and maintain site cure box for cylinders.
2. Cover specimens properly, immediately after finishing. Protect outside surfaces of cardboard molds, if used, from contact with sources of water for first 24 hours after molding.
3. Cure test cylinders per ASTM C 31 as follows:
 - a. To verify compressive strength prior to form removal or for additional test cylinders required due to cold weather concreting conditions:
 - 1) Store test specimens on structure as near to point of sampling as possible and protect from elements in same manner as that given to portion of structure as specimen represents.
 - 2) Transport to test laboratory no more than 4 hours before testing. Remove molds from specimens immediately before testing.
 - b. To verify 28-day compressive strength:
 - 1) During first 24 hours after molding, store test specimens under conditions that maintain temperature immediately adjacent to specimens in range of 60 to 80 degrees F. and prevent loss of moisture from specimens.
 - 2) Remove test specimens from molds at end of 20 +/- 4 hours and store in moist condition at 73.4 +/- 3 degrees F. until moment of test. Laboratory moist rooms shall meet requirements of ASTM C 511.
4. Compression test for non-prestressed concrete:
 - a. Test one set of cylinders at 7 days.
 - b. Test one set of cylinders at 28 days.
 - c. Hold one set of cylinders in reserve for use as Engineer/Architect directs.
5. Unless notified by Engineer, reserve cylinders may be discarded without being tested after 56 days.

- G. Report all nonconforming test results to Engineer and others on distribution lists via fax or email. Follow up with colored paper copies to flag the non-conformances.

3.15 EVALUATION AND ACCEPTANCE OF CONCRETE

- A. Concrete Compression test will be evaluated by Engineer in accordance with ACI 301. If number of tests conducted is inadequate for evaluation of concrete or test results for any type of concrete fail to meet specified strength requirements, core tests may be required as directed by Engineer. Air content and parameters of air-void system shall meet requirements of this Section.
- B. Core tests, when required, in accordance with ASTM C42 and ACI 301.
- C. Should tested hardened concrete meet Specifications, Owner will pay for coring and testing of hardened concrete. Should tested hardened concrete not meet Specifications or should concrete have to be tested because Contractor did not conform to Project specifications, Contractor shall pay for coring and testing of hardened concrete and for any corrective action required for unaccepted concrete.

3.16 ACCEPTANCE OF STRUCTURE

- A. Acceptance of completed concrete Work will be according to provisions of ACI 301.
- B. Concrete rejected due to entrained air content below specified limit will be accepted if any of following conditions are met:
 - 1. ASTM C 457: Three concrete specimens tested in accordance with ASTM C 457 meet air void parameters of Part 2.
 - 2. ASTM C 457: Three concrete specimens tested shall meet air void parameters of concrete reported and approved by Engineer in Part 1.
 - 3. ASTM C 666, Test Procedure A: Test three concrete specimens removed from structure. Concrete specimens tested shall have durability characteristics similar to that reported in Part 1.

END OF SECTION 033000

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CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #:
Project Name:

I. GENERAL INFORMATION:	
Project:	City:
General Contractor:	
Concrete Supplier:	
Mixture Identification No.:	Concrete Grade:
Use (Describe) ¹ :	

¹ Example: Footings, interior flatwork, floor slabs, topping, columns, etc.

II. MIXTURE PROPORTIONING DATA:		
Proportioning Based on (Check only one): Standard Deviation Analysis: _____ (See Section VIII) or Trial Mix Test Data: _____ (See Section IX)		
Mixture Characteristics: (See Mixtures in Drawings General Notes)	Density: _____ pcf;	Air: _____ % specified
	Slump _____ in. before superplasticizer	Slump _____ in. after superplasticizer Or for SCC: Spread _____ in.
	Strength: _____ psi (28 day);	

WALKER SUBMITTAL STAMP

CONTRACTOR

SUBMITTAL STAMP

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #:
Project Name:

III. MATERIALS:		
Aggregates: (size; type; source; gradation report; specification)		
Coarse:		
Fine:		
Other Materials:	<u>Type</u>	<u>Product-Manufacturer (Source)</u>
Cement:		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processed Ultra Fine Fly Ash		
HRM		
Air Entraining Agent:		
Water Reducer		
High Range Water Reducer (HRWR / superplasticizer)		
Non-Corrosive Accelerator		
Retarder		
Fibers		
Other(s):		

IV. MIX PROPORTIONS ⁽²⁾		
	WEIGHT (lbs.) (per yd ³)	ABSOLUTE VOL. (cu. ft.) (per yd ³)
Cement:		
Fine Aggregate: ⁽³⁾		
Coarse Aggregate: ⁽³⁾		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processes Ultra-Fine Fly Ash		
HRM		
Water: ⁽⁴⁾ (gals. & lbs.)		
Entrained Air: (oz.)		
Fibers:		
(Other) _____:		

TOTALS:		
NOTES:		
⁽²⁾ Mix proportions indicated shall be based on data used in section VII or IX.		
⁽³⁾ Based on saturated surface dry weights of aggregates.		
⁽⁴⁾ Includes ALL WATER, including added water and free water contained on aggregates.		

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #:
Project Name:

V. RATIOS	VI. SPECIFIC GRAVITIES
Water ⁽¹⁾ _____ = _____ lb. _____ = _____	Fine Aggregate: _____
Cementitious Material ⁽²⁾ _____ = _____ lb. _____ = _____	Coarse Aggregate: _____
Fine Agg. _____ = _____ lb. _____ = _____	_____
Total Agg. _____ = _____ lb. _____ = _____	_____
NOTES: ⁽¹⁾ Includes ALL water, including added water and free water contained on aggregates. ⁽²⁾ Cementitious materials include cement, fly ash, slag, silica fume, HRM, Processed Ultra-Fine Fly Ash or other pozzolan.	

VII. ADMIXTURES				
Air Entraining Agent (A.E.A.):	___ oz.	per yd ³	___ oz.	per 100# cement
Superplasticizer	___ oz.	per yd ³	___ oz.	per 100# cement
Water Reducer	___ oz.	per yd ³	___ oz.	per 100# cement
Non-corrosive Accelerator	___ oz.	per yd ³	___ oz.	per 100# cement
Retarder	___ oz.	per yd ³	___ oz.	per 100# cement
Other	___ oz.	per yd ³	___ oz.	per 100# cement
Lithium Nitrate	___ gal.	per yd ³		

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #:
Project Name:

VIII. STANDARD DEVIATION ANALYSIS:	<u>Yes</u>	<u>N/A</u>
(Complete this section only if Mixture was developed using standard deviation analysis of previous project test results. If other method was used, check "N/A".)		
<u>Number of Tests Evaluated:</u> <u>(One test is average of two cylinder breaks)</u>	<u>Standard Deviation:</u> <u>(Single Group)</u>	
<u>Attach copy of test data considered:</u>	<u>Standard Deviation:</u> <u>(Two Groups)</u>	
Required average compressive strength: $f'_{cr} = f'_c + \rule{1.5cm}{0.4pt}$ psi		
<p>NOTE: Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'_{cr} equal to or greater than the larger of one of the following equations:</p> <p>(4.-3) $f'_{cr} = f'_c + 1.34ks$ [s = calculated standard deviation] or (4-4) $f'_{cr} = f'_c + 2.33ks - 500$ or (4-5) $f'_{cr} = 0.9f'_c + 2.33ks$ (for $f'_c > 5,000$ psi)</p> <p>(Refer to ACI 301 for required average when data are not available to establish standard deviation. For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.)</p>		
MIXTURE CHARACTERISTICS (As shown on drawings)		
Slump = <u> </u> in.	Air Content = <u> </u> %	
Unit Wet Wt. = <u> </u> pcf	Unit Dry Wt. = <u> </u> pcf	
MIXTURE CHARACTERISTICS (Based on proportioning data)		
Initial Slump = <u> </u> in.	Final Slump = <u> </u> in.	
Unit Wet Wt. = <u> </u> pcf.	Unit Dry Wt. = <u> </u> pcf.	
Air Content = <u> </u> %		

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #:
Project Name:

IX. TRIAL MIXTURE TEST DATA:		<u>Yes</u>	<u>N/A</u>
(Complete this section only if Mixture Proportion is based on data from trial test mixture(s) batched by testing agency or Contractor. If other method was used, check "N/A".)			
<u>Age</u> (days)	<u>Mix #1</u> (comp. str.)	<u>Mix #2</u> (comp. str.)	<u>Mix #3</u> (comp. str.)
<u>7</u>			
<u>7</u>			
<u>28</u>			
<u>28</u>			
<u>28</u>			
<u>28</u> day average compressive strength, psi			
<p>NOTE: Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'_{cr} equal to or greater than the larger of one of the following equations:</p> <p>(Less than 3000) $f'_{cr} = f'_c + 1000$ or (3000 to 5000) $f'_{cr} = f'_c + 1200$ or (Over 5000) $f'_{cr} = 1.1f'_c + 700$</p> <p>For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.</p>			
MIXTURE CHARACTERISTICS (as shown on drawings)			
Slump = _____ in.		Air Content = _____ %	
Unit Wet Wt. = _____ pcf		Unit Dry Wt. = _____ pcf	
MIXTURE CHARACTERISTICS (Based on proportioning data)			
Initial Slump = _____ in.		Final Slump = _____ in.	
Unit Wet Wt. = _____ pcf.		Unit Dry Wt. = _____ pcf.	
Air Content = _____ %			

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #:
Project Name:

X. OTHER REQUIRED TESTS			
Water Soluble Chloride Ion Content of mix:	_____ % (by weight of cement)		ASTM C 1218
Hardened Air Content (per ASTM C457):			
Air content: _____ %	Air void spacing Factor _____ in.	Specific surface: _____ in ² /in ³	
Chloride Ion Content of Concrete Mixture: ASTM C 1218			
Shrinkage (Length Change, Average) per ASTM C157:			
_____ % @ 4 days	_____ % @ 7 days	_____ % @ 14 days	
_____ % @ 21 days	_____ % @ 28 days		

XI. Remarks:			

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #:
Project Name:

SUBMITTED BY:

Ready Mix Concrete Supplier Information
Name:
Address:
Phone Number:
Date:
Main Plant Location:
Miles from Project Site:
Secondary or Backup Plant Location:
Miles from Project Site:

My signature below certifies that I have read, understood, and will comply with the requirements of this Section.

Signature _____

Typed or Printed Name _____

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #:
Project Name:

REQUIRED ATTACHMENTS:	
	Coarse aggregate grading report
	Fine aggregate grading report
	Concrete compressive strength data used for calculation of required average strength and for calculation of standard deviation
	Chloride ion data and related calculations
	Admixture compatibility certification letter
	Shrinkage information per ASTM C157
	ASTM C 457
	Alkali Content Data and Calculations OR ASTM C1293, ASTM C1260, ASTM C 1567 or CE CRD-C662 Test report for each aggregate

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #:
Project Name:

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SECTION 034100 - PRECAST CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes plant-precast structural concrete units, including the following:
 - 1. Precast structural concrete units.
 - 2. Solid slab units.
 - 3. Long-span units.
 - 4. Structural framing units.
 - 5. Precast structural concrete with architectural finishes.
 - 6. Precast structural concrete with architectural thin-brick-faced finishes.
- B. Assigned Work:
 - 1. All provisions of Division 07 Sections shall remain in effect.
 - 2. Provisions stated herein apply to all plant-precast concrete, whether structural or architectural.
- C. Related Sections:
 - 1. Division 03 Section "Cast-In-Place Concrete", for concrete topping and installing connection anchors in concrete.
 - 2. Division 05 Section "Metal Fabrications", for stair nosing, kickers, and other miscellaneous steel shapes.
 - 3. Division 07 Section "Traffic Coatings"
 - 4. Division 07 Section "Water Repellents"
 - 5. Division 07 Section "Concrete Joint Sealants"
 - 6. Division 07 Section "Expansion Joint Assemblies"

1.3 SYSTEM DESCRIPTION

- A. System described here is intended to perform in ACI 362.1R-97 Zone II environment without long-term corrosion or other distress. If maintained per manufacturer's recommendations, system is expected to function satisfactorily for 40 years.
- B. Drawings show structural reinforcement designed to resist loads imposed upon pieces in final service condition.
- C. Drawings show precast member sizes assumed and used as basis for Architectural Drawings and Details and foundation design. Alternate member sizes will be accepted only if structurally

required and if of no significant effect on foundations or architecture. See section 1.5, "Performance Requirements" for additional discussion.

- D. Design structural reinforcement required to resist handling and erection stresses.
- E. See Drawings for:
 - 1. Precast concrete member load requirements.
 - 2. Minimum entrained air.
 - 3. Minimum compressive strength.
 - 4. Maximum water cementitious materials ratio.
- F. All precast concrete pieces require design by precast concrete manufacturer, unless noted otherwise on Drawings.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, per Section "Cast-In-Place Concrete."
- B. Concrete Mixture Proportions: Submit concrete mixture proportions for each concrete mixture in accordance with Section "Cast-In-Place Concrete."
- C. Shop Drawings: Detail fabrication and installation of precast structural concrete units. Indicate member locations, plans, elevations, dimensions, shapes, cross sections, openings, support conditions, and types of reinforcement, including special reinforcement.
 - 1. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, inserts, connections, and joints, including accessories.
 - 2. Indicate locations and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 3. Instead of submitting shop drawings for all piece marks, precaster shall submit shop drawings for typical pieces only along with reinforcing detail drawing for corresponding calculations.
 - 4. Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation.
 - a. Include calculated fire-resistance analysis.
 - b. Include a summary of the design criteria.
 - c. Where used in design of double tees, submit current test results substantiating that minimum shear reinforcing per ACI 318-08, Section 11.4.6.2 is permitted to be waived. (This testing does not waive the minimum stem reinforcing specified for this project in specification article, "Performance Requirements").
 - 5. Provide engineering analysis summary for the precast concrete structural loading that is applied to the foundations:
 - a. Locate and identify all loads that the precast concrete applies to the foundation system. Include vertical and lateral load reactions and graphically key the reactions to the plan and elevation drawings for engineer's use in verifying foundation design criteria.
 - b. Schedule the submittal of precast concrete structural loading reactions on the General Contractor's project schedule.

- c. Changes to the foundation loading not identified as alternates, shall be the responsibility of the contractor. Changes to the foundation reinforcing or embeds shall be the responsibility of the Contractor. Costs from changes that result in redesign, repair or construction changes shall be borne by the Contractor.
- D. Repair/Alteration documents: After submission of shop drawings any repairs, alterations or modifications shall be submitted by the precaster for review. All repair/alteration documents shall bear the seal and signature of qualified registered professional Engineer licensed to perform work in The State of North Carolina.
- E. Samples: For each type of finish indicated on exposed surfaces of precast structural concrete units, in sets of 3, illustrating quality of finishes, colors, and textures; approximately 12 by 12 by 2 inches.
- F. Welding Certificates: Copies of certificates for welding procedures and personnel.
- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of engineer/architects and owners, and other information specified.
- H. Material Certificates: Signed by Manufacturer that each of the following items conforms to requirements.
 - 1. Concrete materials.
 - 2. Reinforcing materials and prestressing tendons.
 - 3. Admixtures.
 - 4. Bearing pads.
- I. Proof of certification of precast concrete supplier's plant under Prestressed Concrete Institute plant certification program.
- J. Letter of Qualification, furnished by Precast/Prestressed Concrete Institute confirming that erector is fully certified in Structure Category S2.
- K. Proof of precast erector qualification under PCI Certified Erector Program.
- L. Proof of precaster erector's superintendent's qualification as Certified Field Auditor.
- M. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner will in turn reimburse Engineer.
- N. Requests For Information:
 - 1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.

2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the Contract Documents.
- O. Sample Panel: Architectural precast concrete fabricator shall make three-foot square samples for finish selection only. If rejected, another set of samples shall be made for review, until acceptable sample is made. After acceptance of finish sample, architectural precast concrete fabricator shall make one full height by 6-foot wide sample panel of each exterior spandrel, designated "architectural precast concrete" on Drawings. Sample panels will be reviewed at precast plant by Engineer/Architect. If rejected, another set of sample panels shall be made for review, until acceptable samples are made. If accepted, sample panels shall be held at plant until production is complete, then shipped to site and held there until completion and acceptance of Project, when Contractor shall remove it from site.
- P. Samples for each thin brick unit required, including special shapes, showing the full range of colors, textures, and dimensions expected.

1.5 PERFORMANCE REQUIREMENTS

- A. Parking structure contract drawings are based on performance type design for precast superstructure. Unless noted otherwise, all precast member size shown on the structural drawings are minimum sizes and shall not be reduced without the approval of the Engineer. An integral part of this project is preparation of final design drawings. Design calculations and shop drawings as required in accordance with this Section, and specifications necessary for fabrication and construction of all precast concrete pieces and required accessories in accordance with all code and engineering requirements.
- B. Design Drawings and Specifications: Precast supplier shall employ qualified registered professional Engineer/Architect, licensed in The State of North Carolina to perform such design and acceptable to Engineer/Architect. Such design shall meet criteria established in these documents. This professional (hereinafter referred to as Designer) shall prepare and seal final structural design drawings, design calculations, shop drawings, and specifications (hereinafter referred to as Design Documents) submitted to Engineer/Architect for review. Designer shall be responsible for structural design for Project and will be required to submit design calculations and shop drawings to Engineer/Architect for review prior to any fabrication and construction for Project. For those pieces for which Designer has design responsibility, Designer shall also prepare and seal drawings and calculations for submittal to proper governing authorities as required.
- C. Submission of Final Design Documents: Precast supplier shall submit final Design Documents to Engineer/Architect for review in ample time to allow such review before proceeding with any fabrication or construction. These Design Documents, prepared and sealed by Designer, may be submitted in "stages" to allow for phased construction. These Design Documents shall be completed in every detail necessary for fabrication and construction of Project, complying with design intent and requirements of Contract Documents. See Division 01 Section "Submittals" for Shop Drawings. These shop drawings shall neither be prepared nor be submitted to Engineer/Architect for review until after design drawings, design calculations, and specifications have been accepted by Engineer/Architect. Upon review, Engineer/Architect's written remark "No Exception Taken" shall mean that item, design drawings, calculation, or specification has been accepted for the design intent.

- D. Designer's Insurance and Certificate: Designer will be required to furnish Owner a Certificate of Professional Liability Insurance in minimum amount of \$1,000,000 per claim. All Design Documents prepared by Designer shall be certified (bear seal and signature of Designer registered in The State of North Carolina before they are submitted for review).
- E. Minimum Durability Design Requirements:
1. Double tee flange connectors and anchorages: Stainless steel alloy A304 or alloy 201-LN.
 2. Galvanize entire assembly of all connection hardware (excluding tee to tee connectors) and end bearing plate assemblies. Touch up galvanizing with Z.R.C. after field welds are made.
 - a. Take all necessary precautions to prevent embrittlement of hot-dip galvanized assemblies. (Refer to ASTM A143 and A767).
 3. Provide extra reinforcing around all openings, including door openings: 2 #5 bars all 4 sides of each opening and extend 2 ft beyond corners or opening. Add 2 #5 bars 4 ft long as diagonal bars at each corner.
 4. Coil Rods: Provide 0.75 in. diameter by 2 ft 6 in. minimum coil rods and inserts at following locations as minimum unless other method(s) accepted in writing by Engineer:
 - a. Typical Exterior Columns: Minimum of 2 per column into topping pour, 1 in each column face parallel to spandrel.
 - b. Corner Columns: Minimum of 2 per column into topping pour, 1 in. each interior column face.
 - c. Exterior Spandrels: Minimum of 1 at each double tee stem in load bearing spandrels and minimum of 1 every 4 ft on center for non-loading bearing spandrels into topping pour.
 - d. "Light Wall": Minimum of 1 at each double tee stem into topping pour.
 5. Diaphragm Reinforcing: Precast concrete manufacturer to provide minimum of (3) #5 continuous bars at perimeter of all floor diaphragms cast into precast and cast-in-place topping pour unless alternate reinforcing shown on Drawings.
- F. General Design Criteria:
1. Unless noted otherwise, all design shall be in accordance with governing codes, standards and references listed in Drawing General Notes and in this Section.
 2. Maximum self-weights (using normal weight concrete for all pieces) and minimum concrete strengths shall be per sections shown, Drawing General Notes and as noted herein.
 3. Pieces shall be designed considering all vertical loads, lateral loads due to wind, seismic, temperature differentials, shrinkage, shortening, and effects due to prestressing.
 4. All precast surfaces to receive cast-in-place concrete topping shall be rough to allow proper bond per ACI 318, Section 17.5.
 5. All pieces shall have fire ratings as specified in Drawing General Notes.
 6. Ultimate design capacity of inserts, coil rods, and coil bolts in tension shall not be greater than 90% of yield capacity of weakest piece.
 7. Minimum concrete cover of reinforcement, prestressing strands, etc. shall be based on ACI 318, Section 7.7.3a. Concrete cover at top of members shall be 1-1/2 inches consistent with ACI-362.1R-97(02), "Guide For The Design Of Durable Parking Structures."
 8. Water/cement ratio for all pieces shall be ≤ 0.40 .
 9. See heading "Precast System Design Criteria" for additional piece design criteria.

G. Precast System Design Criteria:

1. Double Tees:

- a. Design shall include type, number, and location of strands, flange reinforcement, shear reinforcement, cast-in-place concrete topping reinforcement, end bearing plate and confinement reinforcement. Prestress in accordance with provisions of this Specification and referenced standards, codes, etc. Entire assembly of end bearing plates shall be hot dipped galvanized.
- b. Design flanges to support design dead load and either uniform (design) live load or 3000 lb concentrated wheel live load acting on area $4\frac{1}{2}" \times 4\frac{1}{2}"$ (located to produce maximum stress condition), whichever provides greater stresses.
- c. Where permitted by Governing Code, live loads may be reduced. Double tees may be designed as Class T or Class C according to ACI 318, Sections 18.3 and 18.4.
- d. Live load deflections shall meet requirements of ACI 318 Table 9.5 (b). Total dead load plus live load deflection, including long term effects, shall not adversely affect drainage.
- e. As determined by project conditions, design as "restrained" or "unrestrained" pieces for purposes of fire rating requirements. Use ASTM E119, Appendix X3 and Table X3.1 to determine restraint conditions. Minimum cover of reinforcement, prestressing strands, etc., and other fire rating design criteria shall be based on this premise.
- f. Surface to receive topping shall be rough to allow proper bond per ACI 318, section 17.5.
- g. Flange connections shall be stainless steel alloy A304 or 201-LN "Vector Connector" by JVI, Inc., or accepted equal.
- h. Shear reinforcement consisting of stem mesh shall be provided 5'-0" minimum in each stem at each end but not less than required by design.

2. Beams: Exterior and Interior "L," Inverted Tee, Exterior and Interior Pocketed, and Spandrel (Non-Load Bearing):

- a. Design shall include type, number, and location of longitudinal reinforcement, shear and torsion reinforcement, end bearing plates and confinement reinforcement, connection requirements, and ledge reinforcement. Ledge reinforcement shall be designed per PCI Design Handbook, current Edition, Section 4.5. Continuity shall be maintained between both faces of reinforcement at ends of pieces. Inverted tee beams and L-beams may be designed as composite sections, but overhanging flanges shall not be considered as part of the effective section, except in fully topped precast design.
- b. Bumper loads shall be as noted in Drawing General Notes.
- c. Where permitted by Governing Code, live loads may be reduced. Prestressed beams may be designed as Class T or Class C according to ACI 318, Sections 18.3 and 18.4 except beams exposed to weather, such as spandrel beams, shall be designed as Class U.
- d. Live load deflections shall meet requirements of ACI 318 Table 9.5 (b). Total dead load plus live load deflection, including long term effects, shall not adversely affect drainage.
- e. Torsion design shall be per PCI Design Handbook, current Edition, Section 4.4 and ACI 318.
- f. Skew ends of beams as required for sloping bays.
- g. Prestress all pocketed beams.
- h. Pocketed beams shall be 9 in. thick, minimum, with not less than 3 in. concrete thickness behind the pocket, unless beam exterior will receive a permanent coating

that can conceal potential "shadow" at pocket. No reduction of 3 in. thickness permitted. If reveals are behind pockets, thicken beam to maintain 3 in. thickness.

- i. Pocket dimensions in pocketed beams: Width: (double tee stem width + 4 in.), minimum. Depth \leq (double tee stem depth + 2 in.).

3. Columns:

- a. Design shall include number and location of vertical reinforcement, vertical reinforcement splices, shear reinforcement, concrete haunch design, including bearing plates and anchor bolts at foundation. Where pieces are prestressed, minimum ties shall be provided per ACI 318, Section 7.10.5, not Chapter 18.
- b. Pockets shall be sloped as required for beam bearings.
- c. All columns shall be continuous full height. Splice locations, if required, shall be acceptable to Engineer.

4. Connections:

- a. Connections shown on Contract Drawings are minimum and are intended to establish standard of performance. Engineer reserves right to accept or reject alternate details. Design as necessary to transfer gravity loads, lateral loads, torsion forces and forces due to volume change effects. Design shall meet or exceed PCI recommendations.
- b. Use minimum additional load factor of 1.2 for design of all superstructure connections. Connections are any elements that mechanically tie separate members together. Column haunches, beam and tee end bearing plates, etc. are considered part of member design and not subject to the additional load factor. Restraint developed by friction between bearing pads and connection pieces shall not be considered to contribute to connection. Positive connections shall be made by welds, bolts, or cast-in-place reinforcement. Design in accordance with "PCI Design Handbook – Precast Prestressed Concrete," Seventh Edition.
- c. Bearing pads shall be provided by precast subcontractor as shown on Contract Drawings. Refer to Part 2 Article "Bearing Pads" for additional information.
- d. Beam to column bearing pads shall not extend under beam ledge unless ledge is designed for bearing or recessed to prevent bearing.
- e. Design column and wall base plates and shims so that base plate grouting is not needed prior to erection of pieces supported by column or wall.
- f. Provide continuous reinforcing bars, as shown on the drawings or two #4 bars minimum, immediately above and below inserts resisting bumper loading.

1.6 QUALITY ASSURANCE

- A. "Engineer/Architect" in this Section is defined as Structural Engineer/Architect of Record.
- B. Installer (Erector) Qualifications: Precast concrete erector shall be fully certified in Structure Category S2 by Precast/Prestressed Concrete Institute prior to beginning work.
- C. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in manufacturing precast structural concrete units similar to those indicated for this Project and with a record of successful in-service performance.

1. Contractor assumes responsibility for engineering precast structural concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 2. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in The State of North Carolina and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of precast structural concrete that are similar to those indicated for this Project in material, design, and extent.
 3. Participates in PCI's Plant Certification program and is designated a PCI-certified plant for Group C, Commercial (Structural) - Category C3.
 4. Participates in PCI's Plant Certification program and is designated a PCI-certified plant for Group CA, Commercial Products with an Architectural Finish - Category CA3.
 5. Has sufficient production capacity to produce required units without delaying the Work.
- D. Design Standards: Comply with ACI 318 and the design recommendations of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete."
- E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and camber and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products."
1. Element tolerances and erection tolerances shall comply with PCI MNL 135-00 "Tolerance Manual for Precast and Prestressed Concrete Construction".
 2. The Precast Concrete fabricator shall identify and coordinate specific project tolerance requirements and interfacing tolerances associated with other materials or systems which interface with the precast.
 3. Element and erection tolerances for Group CA – Commercial Products with an Architectural Finish shall comply with PCI MNL 135-00 "Tolerance Manual for Precast and Prestressed Concrete Construction".
- F. Product Options: Drawings indicate size, profiles, and dimensional requirements of precast concrete units and are based on the specific types of units indicated. Other fabricators' precast concrete units complying with requirements may be considered. Refer to Division 01 Section "Product Substitutions Procedures."
- G. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- H. Determining Fire Resistance Requirement: Where fire-rated units or assemblies are indicated, determine the fire resistance according to the IBC "Prescriptive Fire Resistance" or IBC "Calculated Fire Resistance" method. Alternatively, calculate the fire resistance according to PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete" and in a manner acceptable to authorities having jurisdiction.
- I. Walking Surfaces: Walking areas subject to pedestrian traffic shall provide a smooth, slip resistant walking surface for pedestrians with these minimum requirements:
1. Shall provide walking surfaces in accordance with ASTM – F 1637 Standard Practice for Safe Walking Surfaces.
 2. Shall be designed to comply with "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)". Americans with Disabilities Accessibility Guidelines for Buildings

- and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1-800-872-2253.
3. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:
 - a. Changes in level of less than 1/4 inch in height may be without edge treatment as shown in ADA Figure 303.2 and on the Drawings.
 - b. Changes in Level between 1/4 inch and 1/2 inch in height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3 and on the Drawings.
 - c. Changes in level greater than 1/2 inch in height are not permitted unless they can be transitioned by means of a ramp as shown on Drawings.
 - d. Openings in floor or ground surfaces shall not allow passage of a sphere more than 1/2 inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3 and on the Drawings.
 4. Walkway surfaces shall provide a slip resistant surface.
 - a. Concrete surfaces shall be troweled and finished to provide a slip resistant finish.
 - b. Contractor shall provide sample area with slip resistant surface.
 - c. Static coefficient of friction for walking surfaces shall be measured on a dry surface by the NBS – Brungaber machine using a silastic sensor shoe and shall be 0.6 or larger for a level surface and 0.8 or larger for ramps.
- J. Fire-Test-Response Characteristics: Provide precast structural concrete units and assemblies that comply with the following requirements:
1. Fire-response testing was performed by UL, ITS, or another testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
 2. Fire-resistance-rated assemblies, which are indicated by design designations from UL's "Fire Resistance Directory," from ITS's "Directory of Listed Products," or from the listings of another testing and inspecting agency, are identical in materials and construction to those tested per ASTM E 119.
 3. Products are identified with appropriate markings of applicable testing and inspecting agency.
- K. Mockups: Before installing precast structural concrete units, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Manufacture mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Manufacture mockups in the location and of the size indicated or, if not indicated, as directed by Engineer/Architect.
 2. Sample Panel: Precast concrete fabricator shall make 3-ft sq. samples for finish selection only. If rejected, another set of samples shall be made for review, until acceptable sample is made. After acceptance of finish sample, precast concrete fabricator shall make 2 full height by 6 ft wide sample panels of exterior beam(s) designated "architectural precast concrete" on Drawings. Sample panel will be reviewed at precast plant by Engineer/Architect. If rejected, another set of sample panels shall be made for review, until acceptable sample is made. If accepted, sample panel shall be held at plant until production is complete, then shipped to site (if required) and held there until completion and acceptance of project, when Contractor shall remove it from site.
 3. Notify Engineer/Architect seven days in advance of dates and times when mockups will be constructed.

4. Obtain Engineer/Architect's approval of mockups before starting fabrication.
5. At precaster's plant; maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed.

L. Concrete Testing:

1. Perform and pay for compression tests for all precast concrete work with in-house Quality Control personnel. Testing is subject to observation by Testing Agency hired by Owner. Use certificated test equipment. Unless otherwise specified, conform to PCI MNL 116.
2. Precast Structural Concrete Testing: Sample, test and report concrete in accordance with PCI MNL 116, with following exceptions:
 - a. Testing of concrete PCI MNL 116 section 6.2 shall comply with requirements of ACI 318 – 2008, Chapter 5 – Concrete Quality, Mixing and Placing.
 - b. Required concrete testing shall be performed by qualified technicians. Technicians in charge of sampling concrete; testing for slump, unit weight, yield, air content, temperature; and making and curing test specimens shall be certified in accordance with the requirements of ACI Concrete Field Testing Technician—Grade 1 Certification Program, or the requirements of ASTM C 1077, or PCI-PQPC Level I, II, or III; or an equivalent program.
 - c. Precast supplier shall conduct production testing and monitor testing reports and records to ensure consistency with suppliers reported data and compliance with project requirements.
 - d. Precast supplier shall identify non-compliant testing and non-compliant testing reports shall be promptly distributed to the owner, engineer, registered design professional responsible for the design, contractor, and appropriate subcontractors, appropriate suppliers.
 - 1) Distribute reports to allow timely identification of either compliance or the need for corrective action.
 - 2) Evaluation and acceptance of concrete shall comply with ACI 318 – 08 section 5.6.
 - 3) Evaluation and acceptance of non-compliant tests for concrete entrained air content below specified limit will be accepted if one of following conditions are met:
 - a) ASTM C 457: Three concrete specimens tested in accordance with ASTM C 457 meet the following hardened air void parameters: air void spacing factor of 0.0080 in. maximum and specific surface (surface area of air voids) shall be 600 in² per cu in. of air-void volume, or greater.
 - b) ASTM C 457: Three concrete specimens tested shall meet air void parameters of approved concrete mixture submittal from Part 1.
 - c) ASTM C 666, Test Procedure A: Test three concrete specimens removed from structure. Concrete specimens tested shall have durability characteristics similar to that reported in approved concrete mixture submittal from Part 1.

- M. Precaster shall provide casting schedule to Engineer/Architect with first shop drawings submittal. Precaster shall notify Engineer/Architect 48 hours in advance of casting of each piece type (tees, L-beams, spandrel beams, inverted tee beams, columns, wall panels, or other pieces) so that Engineer/Architect may review reinforcement fabrication at precaster's plant before casting. Engineer/Architect may request notification for specific piece marks.

- N. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 REFERENCES

- A. American Association of State Highway and Transportation Officials (AAASHTO):

1. AASHTO M251, "Plain and Laminated Elastomeric Bridge Bearings."

- B. American Concrete Institute (ACI):

1. ACI 301, "Standard Specifications for Structural Concrete."
2. ACI 305R, "Hot Weather Concreting" Recommendations, not specifications.
3. ACI 306.1, "Standard Specifications for Cold Weather Concreting."
4. ACI 318, "Building Code Requirements for Structural Concrete."
5. ACI 362.1R-97, "Guide for the Design of Durable Parking Structures." Recommendations, not specifications.

- C. American Society for Testing and Materials (ASTM):

1. ASTM A36, "Specification for Structural Steel."
2. ASTM A108, "Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality."
3. ASTM A123, "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products."
4. ASTM A143, "Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement." (Annual Book of ASTM Standards, Vol. 01.06).
5. ASTM A164, "Specification for Electrodeposited Coatings of Zinc on Steel."
6. ASTM A167, "Specification for Stainless and Heat Resistant Chromium Nickel Steel Plate, Sheets, and Strips (A304)."
7. ASTM A184 "Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement."
8. ASTM A185, "Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement."
9. ASTM A276, "Standard Specification for Stainless Steel Bars and Shapes."
10. ASTM A307, "Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength."
11. ASTM A386, "Specification for Zinc Coating (Hot-Dip) on Assembled Steel Products."
12. ASTM A416, "Specification for Uncoated Seven-Wire Stress-Relieved Steel Strand for Prestressed Concrete."
13. ASTM A480, "Standard Specification for Stainless Steel – General Requirements."
14. ASTM A496, "Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement."
15. ASTM A497, "Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement."
16. ASTM A500, "Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing Rounds and Shapes."
17. ASTM A615, "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."

18. ASTM A666, "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar."
19. ASTM A706, "Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement."
20. ASTM A767, "Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement."
21. ASTM A775, "Specification for Epoxy-Coated Reinforcing Steel Bars."
22. ASTM A884, "Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement for Reinforcement."
23. ASTM A934, "Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars."
24. ASTM B633, "Specification for Electrodeposited Coatings of Zinc on Iron and Steel."
25. ASTM C42, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete."
26. ASTM C144, "Standard Specification for Aggregate for Masonry Mortar."
27. ASTM C150, "Specification for Portland Cement."
28. ASTM C173, "Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method."
29. ASTM C231, "Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method."
30. ASTM C265, "Standard Test Method for Calcium Sulfate in Hydrated Portland Cement Mortar."
31. ASTM C457, "Practice for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete."
32. ASTM C881, "Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete."
33. ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)."
34. ASTM D412, "Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension."
35. ASTM E119, "Standard Test Methods for Fire Tests of Building Construction and Materials."
36. ASTM F593, "Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs."
37. ASTM F1554-07a, "Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength."
38. ASTM F1637 02, "Standard Practice for Safe Walking Surfaces."

D. American Welding Society (AWS):

1. AWS D1.1, "Structural Welding Code-Steel."
2. AWS D1.4, "Structural Welding Code-Reinforcing Steel."
3. AWS D19.0, "Welding Zinc-Coated Steel."
4. AWS C2.2, "Recommended Practices for Metallizing with Aluminum and Zinc for Protection of Iron and Steel."

E. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI MSP, "Manual of Standard Practice."

F. Prestressed Concrete Institute (PCI):

1. PCI MNL 116, "Manual for Quality Control from Plants and Production of Precast Prestressed Concrete Products."
2. PCI MNL 120, "Design Handbook Precast Prestressed Concrete." Recommendations, not specifications.
3. PCI MNL 129, "Parking Structures – Recommended Practice for Design and Construction." Recommendations, not specifications.
4. PCI MNL 135, "Tolerance Manual for Precast and Prestressed Concrete Construction."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver precast structural concrete units to Project site in such quantities and at such times to ensure continuity of installation. Store units at Project site to prevent cracking, distorting, warping, staining, or other physical damage, and so markings are visible.
- B. Lift and support units only at designated lifting and supporting points as shown on Shop Drawings.

1.9 SEQUENCING

- A. Furnish anchorage items to be embedded in other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.
- B. Contractor shall coordinate manufacturing, delivery and erection schedules.
- C. Allow adequate time for curing of precast pieces prior to erection as required by Part 3.

1.10 PRODUCT WARRANTY

- A. Provide warranty similar to sample below.
- B. Sample:
 1. Manufacturer warrants that all materials furnished have been manufactured in accordance with the specifications for this project. Manufacturer further warrants that if erection of said material is to be performed by those subject to their control and direction, work will be completed in accordance with the same specifications.
 2. In no event shall manufacturer be held responsible for any damages, liability or costs of any kind or nature occasioned by or arising out of the actions or omissions of others, or for work, including design, done by others; or for material manufactured, supplied or installed by others; or for inadequate construction of foundations, bearing walls, or other units to which materials furnished by the precast manufacturer are attached or affixed.
 3. Period of this warranty shall be 5 years beginning at date of beneficial occupancy. Should any defect [other than hairline cracks: defined as not more than 0.006 in. wide] be discovered after acceptance and occupancy of Project, which can be directly attributed to defect in product material or workmanship not evident at time of initial occupancy, then precast manufacturer shall, upon written notice, correct defects or replace products without expense to Owner, Engineer/Architect or General Contractor. In sole judgment of Engineer/Architect, any defects resulting from issues outlined in paragraph above, or resulting from normal wear and tear, product color changes or improper maintenance procedures are not considered responsibility of precast manufacturer.

1.11 REPAIR WARRANTY

- A. Furnish Owner with written total responsibility guarantee that repairs will be free of defects, water penetration and deterioration related to repair design, workmanship or material deficiency.
- B. Warranty period shall be 5 years commencing with date of acceptance of repair.
- C. Perform any repair under this warranty at no cost to Owner.
- D. Before construction, provide Engineer/Architect with sample of final warranty. Guarantee shall be provided by precaster.

PART 2 - PRODUCTS

2.1 FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
 - 1. The Shockey Precast Group
 - 2. Tindal Corporation
 - 3. Metromont Corporation

2.2 MOLD MATERIALS

- A. Molds: Provide molds and, where required, form-facing materials of metal, plastic, wood, or another material that is non-reactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes.
- B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- C. Connection Blockouts, Covers, Sleeves, Caps:
 - 1. Acceptable manufacturer: High Concrete Accessories, Denver, PA 17517, (800) 508-2583
 - 2. Products:
 - a. "Grouted Connection Tube."
 - b. "Swift-Lift Cover."
 - c. "Double Tee Stem Blockout."
 - d. "Spandrel to Column Connector Sleeve and Closure Cap."
 - 3. Substitutions: None.

2.3 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.
- C. Epoxy-Coated Reinforcing Bars: ASTM A 775 or ASTM A 934, as follows:
 - 1. Steel reinforcement: ASTM A 615, Grade 60
- D. Hot-Dip Galvanized Reinforcing Bars (used in connection hardware and end bearing plate assemblies): ASTM A767.
- E. Steel Bar Mats: ASTM A 184, assembled with clips, as follows:
 - 1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.
- F. Epoxy-Coated-Steel Welded Wire Reinforcement (ECWWR): ASTM A 884, Class A coated, plain.
- G. Plain-Steel Welded Wire Reinforcement (WWR): ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- H. Supports: Manufacturer's bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to CRSI's "Manual of Standard Practice," PCI MNL 116, and as follows:
 - 1. For uncoated reinforcement, use all-plastic bar supports.
 - 2. For epoxy-coated reinforcement, use all-plastic bar supports.

2.4 PRESTRESSING TENDONS

- A. Prestressing Strand: ASTM A 416, Grade 270, uncoated, 7-wire, low-relaxation strand, manufactured in USA.

2.5 CONCRETE MATERIALS

- A. Concrete: See Division 03 Section, "Cast-in-Place Concrete" except as specified here.
 - 1. Portland Cement: ASTM C 150, Type I, II or III as acceptable to Engineer/Architect.

2.6 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates:
 - 1. W-Shapes: ASTM A992
 - 2. All Other Shapes and Plates: ASTM A36
- B. Carbon-Steel Structural Tubing: ASTM A1085

- C. Carbon-Steel Headed Studs: ASTM A 108, Grade 1018 through Grade 1020, cold finished; AWS D1.1, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- D. Malleable Steel Castings: ASTM A 47.
- E. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706.
- F. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers, ASTM F844.
- G. Anchor Rods: ASTM F 1554, Grade 36 or Grade 55.
- H. Inserts and Coil Rods:
 - 1. Provide sizes shown on Drawings.
 - 2. Yield strength: 65,000 psi minimum.
 - 3. Galvanizing: Electrodeposited zinc coating, ASTM B 633, Service Condition 1, Type III where indicated on Drawings.
 - 4. Acceptable manufacturer, general:
 - a. Dayton/Richmond Concrete Accessories, Miamisburg, OH.
 - 5. Acceptable manufacturer for multi-directional inserts: Connection Specialties, Inc. Boystown, NE.
- I. Finish: For exterior steel items, steel in exterior walls, and items indicated for hot-dip process according to ASTM A 123, after fabrication, and ASTM A 153, as applicable.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20: "ZRC Cold Galvanizing Compound," ZRC Worldwide, Marshfield, MA 02050.
- J. Welding Electrodes: Comply with AWS standards.
- K. Accessories: Provide clips, hangers, plastic shims, and other accessories required to install precast structural concrete units.

2.7 STAINLESS-STEEL CONNECTION MATERIALS

- A. Stainless-Steel Plate: ASTM A 666, Type 304, of grade suitable for application.
- B. Stainless-Steel Bolts and Studs: ASTM F593, alloy 304 or 316, hex-head bolts and studs; ASTM F594, alloy 304 or 316, stainless-steel nuts; and flat, stainless-steel washers.
 - 1. Lubricate threaded parts of stainless steel bolts with an antiseize thread lubricant during assembly.
- C. Stainless-Steel Headed Studs: ASTM A 276, Alloy 304 or 316, with minimum mechanical properties of PCI MNL 116.

- D. Electrodes for Welding Type 304 stainless-steel: E 308.
- E. Flange-to-flange field connection plates: ASTM A666, Type 304, or 201-LN of grade suitable for application.

2.8 BEARING PADS

- A. Provide bearing pads for precast structural concrete units as follows:
 - 1. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer.
 - 2. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer.
 - 3. Frictionless Pads: Tetrafluoroethylene, glass-fiber reinforced, bonded to stainless- or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
 - 4. High-Density Plastic: Multimonomer, nonleaching, plastic strip.
- B. Beams: Horizontal bearing pads.
 - 1. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer, unless noted otherwise on Drawings.
 - 2. Acceptable materials:
 - a. "Sorbtex," Voss Engineering Co., Chicago, IL.
 - b. "Capralon," JVI, Inc., Skokie, IL.
 - c. "Viblon," Korolath of New England, Inc. Hudson, MA.
- C. Double Tee Stems: Horizontal bearing pads:
 - 1. Engineered random oriented fiber reinforced bearing pads. Acceptable Materials:
 - a. "Masticord," JVI, Inc., Skokie, IL.
 - b. "Fiberlast," Voss Engineering, Inc., Chicago, IL.
 - c. "Korolath R.O.F. Bearing Pads," Korolath of New England, Inc. Hudson, MA.
- D. Engineered random oriented fiber reinforced bearing pads may be substituted for beam bearing pads where engineering calculations demonstrate adequate capacity, and if accepted in writing by Engineer.
- E. Joints between precast pieces: Non-load bearing vertical spacers only:
 - 1. Fiber impregnated elastomeric bearing pads.
 - 2. Durometer hardness 80 minimum.
 - 3. Acceptable materials:
 - a. "Vossco," Voss Engineering Co., Chicago, IL.
 - b. "Comcord," JVI, Inc., Skokie, IL.
- F. Solid core precast plank: Bearing strips: "Korolath," Koro Corp., Hudson, MA.
 - 1. Bonding Adhesives:

- a. Shim to Shim: "Bostik #3050."
- b. Shim to Carbon Steel: "Bostik #3050."
- c. Shim to Stainless Steel: "Bostik #3050."
- d. Shim to Concrete: "Bostik #7087."

G. Shims for bearing pads:

- 1. Galvanized or epoxy-coated ASTM A 36 steel. Do not stack steel shims more than 3 high. Tack weld multiple shims together on at least 2 faces or corners. Touch up galvanizing or epoxy coating damaged by welding. See Section "Cast-in-Place Concrete" for materials.
- 2. High-Density Plastic: A maximum of 1 plastic shim and a maximum of 1/2" in thickness may be used to adjust for field tolerances. Precaster shall submit certification of bearing capacity of plastic shim materials for approval prior to installation.

H. Slide Bearing Systems at Expansion Joints:

- 1. Provide slide bearing systems as shown and detailed on Drawings:
 - a. Beam and double tee bearings shall be reinforced PTFE: 100% virgin tetrafluoroethylene polymer and ground glass fiber reinforcing aggregate, prebonded to stainless steel and/or preformed fabric (see paragraph "Bearing Pads" under heading "Connection Materials" above) bearing pads. Acceptable slide bearing systems:
 - 1) "Fluorogold," Seismic Energy Products, LP, Pine Brook, New Jersey.
 - 2) "Balco," Balco, Inc., Wichita, Kansas.
 - 3) "Dura-Slide," Tobi Engineering, Inc., Elk Grove Village, Illinois.
 - 4) "Dynalon Slide Bearings with Masticord," JVI, Inc., Skokie, Illinois.
 - b. Slab and plank bearing shall be ultrahigh molecular weight, high-density polyethylene resin: Acceptable material:
 - 1) "Korolath PE," Korolath Corporation, Hudson, Mass.
 - 2) "Tivar-100," Poly-Hi/Menasha Corporation, Fort Wayne, Indiana.
 - 3) "UHMW Econ-o-Shim," Deslousiers, Inc., Bellwood, IL.
- 2. Backing material for reinforced PTFE slide bearing systems as shown on Drawings:
 - a. Galvanized steel.
 - b. Stainless steel.
 - c. Reinforced elastomer, having durometer hardness of 90 plus or minus 5 and meeting requirements of Article 2.10.3(L) of AASHTO Standard Specifications for Highway Bridges (1983).

2.9 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-

reducing agents, complying with ASTM C 1107, of consistency suitable for application.
Acceptable materials:

1. "Hi-Flow Grout" by The Euclid Chemical Company.
2. "Masterflow 928" by BASF.

Non-shrink dry-pack grout from these manufacturers may also be used in areas where flowing or fluid grout is not required.

- C. Epoxy Grout: ASTM C 881, 2-component epoxy resin, of type, grade, and class to suit requirements.
- D. Backer rod for grouted and sealed joints: Division 07 section, "Concrete Joint Sealants."

2.10 CONCRETE MIXTURES

- A. Prepare concrete mixture proportions for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
 - 1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
 - 2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.
- B. A qualified independent testing agency may be engaged by Fabricator for preparing and reporting proposed mixture proportions for the laboratory trial mix basis.
- C. Requirements for concrete mixture proportions are shown on Drawings:
 - 1. Compressive strength
 - 2. Slump
 - 3. Water-cementitious materials ratio
 - 4. Air content
- D. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 318 requirements.
 - 1. Fly ash or other pozzolans conforming to ASTM C 618: 25 percent
 - 2. Slag conforming to ASTM C 989: 50 percent
 - 3. Processed ultra-fine fly ash conforming to ASTM 618: 25 percent
 - 4. Total of fly ash or other pozzolans and slag: 50 percent. Within the total, fly ash or other pozzolans not exceeding 25 percent.
- E. Air Entrainment:
 - 1. See General Notes on Drawings for total average air content (percent by volume).
 - 2. Average air content shall exceed value stated in General Notes on Drawings.
 - 3. Permissible variation for any one test result from specified average total air content: plus or minus 1.5 percent.
 - 4. Hardened concrete shall have an air void spacing factor of 0.0080 in. maximum. Specific surface (surface area of air voids) shall be 600 in² per cu in. of air-void volume, or greater. Concrete mixes not meeting these values as determined by ASTM C 457 may require adjustments unless accepted in writing by Engineer. Refer to Part 1 Article "Submittals."

F. Chloride Ion Content of Mixture:

1. Water soluble chloride ion content of mix (including all constituents) shall not exceed 0.06% chloride ions by weight of cement for prestressed concrete and 0.15% for reinforced concrete. Test to determine chloride ion content shall conform to ASTM C 1218.
2. Concrete chloride ion content shall be determined by Testing Agency prior to placement. Cast samples from current production of concrete mix proposed for superstructure.
3. Concrete not meeting the requirements of paragraph "Water soluble chloride ion content of mix..." above, shall contain appropriate amount of calcium nitrite. Concrete supplier shall provide laboratory test results showing the amount of excess chloride ion content in the concrete mixture contributed by the aggregates. For each pound of chloride ion in excess of the amount allowed, mix shall contain calcium nitrite (30%, +/- 2%, solids content) on one-to-one basis (one gallon of calcium nitrite for one lb of excess chloride ion). Maximum of 1.5 lb of chloride ion per cubic yard may be offset in this manner.

G. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use high range water-reducing admixture in pumped concrete, concrete for parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio of 0.45 or less. Use normal or mid-range ASTM Type A water reducing admixture for concrete with water-cementitious materials ratio greater than 0.45.

H. Silica fume or high reactivity metakaolin concrete: When desired mix properties are achieved, two 12 in. x 12 in. x 4 in. thick slabs shall be prepared for each mixture with test samples taken by drilling four 4 in. diameter cores. Drilled cores shall be tested for rapid chloride permeability in accordance with Test Method ASTM C 1202. Slab shall be moist cured for 28 days and cores removed and kept at 50% relative humidity until testing at 35 to 42 days. In lieu of drilled cores it is permissible to mold 4 in. x 8 in. cylinder specimens in accordance with ASTM C 31. Concrete mixture proportions submitted shall have an average chloride permeability result of less than 800 coulombs for four cores tested, with no single test result exceeding 1000 coulombs.

I. Engineer's acceptance of mixture shall not relieve precast concrete fabricator from responsibility for any variation from requirements of Contract Documents unless precast concrete fabricator has in writing called Engineer's attention to each such variation at time of submission and Engineer has given written approval of each such variation.

J. Adjustment to Concrete Mixtures: Mixture proportion adjustments may be requested by precast concrete fabricator when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Laboratory test data for revised mixture proportions and strength results must be submitted to and accepted by Engineer before using in work.

2.11 FABRICATION

A. Formwork: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances.

1. Coat surfaces of forms with bond-breaking compound before reinforcement is placed. Provide commercial-formula, form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's written instructions.
 2. Unless forms for precast, prestressed concrete units are stripped before detensioning, design forms so stresses are not induced in precast concrete units because of deformation or movement of concrete during detensioning.
- B. Built-in Anchorages: Accurately position built-in anchorage devices and secure to formwork. Locate anchorages where they do not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in units unless accepted by Engineer/Architect [and specialty design engineer].
- C. Cast-in openings larger than 10 inches in diameter or 10 inches square according to Shop Drawings. Smaller holes may be field cut by trades requiring them, as accepted by Engineer/Architect, but shall not damage or spall the precast finish.
- D. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.
 2. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete-placement operations. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.
 3. Place reinforcement to obtain the specified concrete cover. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
 4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
1. Delay detensioning until concrete has reached at least [70] percent of its compressive strength as established by test cylinders cured under the same conditions as concrete.
 2. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 3. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
- F. Mix concrete according to PCI MNL 116 and requirements in this Section. After concrete batching, no additional water may be added.
- G. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 116 for measuring, mixing, transporting, and placing concrete.
1. Place backup concrete mixture to ensure bond with face-mixture concrete.

- H. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL 116.
 - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- I. Comply with ACI 306.1 procedures for cold-weather concrete placement.
- J. Comply with ACI 305R recommendations for hot-weather concrete placement.
- K. Identify pickup points of precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint casting date on each precast concrete unit so that it will not show in finished structure.
- L. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Limit concrete temperature to 140° F during accelerated curing unless test data is submitted that cement is not subject to delayed ettringite formation (DEF).
- M. Form edges of double tee flanges to conform with configurations shown on Drawings:
 - 1. Coordinate joints with expansion joint and control joint sealant system.
 - 2. Drysaw unacceptable formed joints with 0.1875 in. carborundum blade.
- N. For protection against corrosion, coat exposed ends of prestressing strands in all prestressed pieces with BASF "MasterSeal 610, 614, or 615," or accepted equivalent.
- O. Locate lift loops and erection inserts so as not to be visible in completed construction. Provide all lift loops and erection inserts with 1.5 in. minimum concrete or grout cover in completed construction. Any lift loops or erection inserts that must be located in areas that will be exposed to public view in completed construction or are in elevator shafts shall be recessed and patched with:
 - 1. Minimum of 1.5 in. drypack, latex modified concrete grout to match surrounding concrete.
 - 2. Minimum of 1.5 in. sealant (see Division 07 Section "Concrete Joint Sealants") color to match surrounding concrete.
 - 3. Mechanically fastened plastic covers, color to match surrounding concrete.
- P. Galvanize entire assembly of all inserts, angles and other cast-in-steel devices exposed on surface of precast concrete where shown on Drawings.
- Q. Permit access by Engineer/Architect, Owner, and Owner's representatives to all parts of manufacturing facility.
- R. Mark each piece of precast concrete for identification and date of casting recorded. Marks shall not be visible after erection and completion of Work.

2.12 FABRICATION TOLERANCES

- A. Fabricate precast concrete structural units straight and true size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 for product dimension tolerances as well as position tolerances for cast in items.
- B. MNL 135, Tolerance Manual for Precast Prestressed Concrete Construction

2.13 FINISHES

- A. Structural Precast Concrete: Provide finishes in accordance with MNL-116 and as follows:
 - 1. Formed surfaces: Fill air pockets and holes over 0.25 in. in diameter with sand-cement paste and grind smooth all form offsets or fins over 0.125 in.
 - 2. Precast concrete surfaces that will provide a pedestrian walking surface shall conform to Article "Quality Assurance, paragraph "Walking Surfaces".
 - 3. All precast surfaces to receive a cast-in-place concrete topping shall be transverse raked to 0.25 in. depth minimum to insure bond of topping.
 - 4. Columns at Interior Locations:
 - a. All faces: Smooth dense standard finish and/or steel trowel finish.
 - 5. Columns at Exterior Locations:
 - a. Interior face: Steel trowel finish.
 - b. Exterior face and side faces: Light sandblast of smooth dense standard finish.
 - 6. Wall Panels at Interior Locations, Light Wall Panels, and Shear Walls:
 - a. All faces: Smooth dense standard finish and/or steel trowel finish.
 - 7. Wall Panels at Exterior Locations:
 - a. Interior face and unexposed side faces: Steel trowel finish.
 - b. Exterior face and exposed side faces: Refer to architectural elevations for locations of the two following finishes:
 - 1) Thin Brick Units.
 - 2) Light sandblast of smooth dense standard finish.
 - 8. Spandrel Beams:
 - a. Interior face: Light broom finish.
 - b. Top face and unexposed end faces: Smooth dense standard finish and/or steel trowel finish.
 - c. Exterior face, bottom face, and exposed end face: Refer to architectural elevations for locations of the two following finishes:
 - 1) Thin Brick Units.
 - 2) Light sandblast of smooth dense standard finish.
 - 9. Double Tees:
 - a. Tee areas without cast-in-place concrete topping: Top surface shall have medium broom finish in longitudinal direction. All sides, ends and bottom: Smooth dense standard finish.

- b. Top surfaces that provide a pedestrian walking surface shall conform to Article "Quality Assurance", paragraph "Walking Surfaces".
 - c. Depressor holes: Filled with non-shrink, non-staining grout.
10. Stair Treads and Landings:
- a. Horizontal surfaces in final orientation shall have slip resistant finish in accordance with Article "Quality Assurance", paragraph "Walking Surfaces".

2.14 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements.
- B. Precast concrete units will be considered deficient if units fail to comply with PCI MNL 116 requirements, including the following:
 - 1. Units fail to comply with compressive-strength test requirements.
 - 2. Units fail to comply with entrained air content test requirements.
 - 3. Reinforcement and prestressed tendons of units do not comply with fabrication requirements.
 - 4. Concrete curing and protection of units against extremes in temperature fail to comply with requirements.
 - 5. Units are damaged during handling and erecting.
- C. Testing: If there is evidence that the strength of precast concrete units may be deficient or may not comply with PCI MNL 116 requirements, Owner will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42.
 - 1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Engineer/Architect.
 - 2. Test cores in an air-dry condition or, if units are wet under service conditions, test cores after immersion in water in a wet condition.
 - 3. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength.
 - 4. Test results will be made in writing on the same day that tests are performed, with copies to Engineer/Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit or units represented by core tests; design compressive strength; type of break; compressive strength at break, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

- D. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mix that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- E. Dimensional Tolerances: Units with dimensions smaller or larger than required and not complying with tolerance limits may be subject to additional testing.
 - 1. Precast concrete units with dimensions larger than required will be rejected if the appearance or function of the structure is adversely affected or if larger dimensions interfere with other construction. Repair or remove and replace rejected units, as required, to comply with construction conditions.
- F. Precaster's Quality Control inspector shall inspect all pieces immediately after pieces have received final finish.
- G. Pieces shall be inspected and defects numbered on back of control tags attached to the back of each piece according to the following system:
 - 1. Foreign material in face.
 - 2. Bug holes.
 - 3. Rough or chipped edges.
 - 4. Cold joints.
 - 5. Form Lines.
 - 6. Cornice details.
 - 7. Uniformity of finish.
 - 8. Uniformity of retarder.
 - 9. Finish at retarder surround.
 - 10. Finish on return surfaces.
- H. Precaster's finishers shall correct defects in precaster's plant or yard. As defects corrected, finishers shall write an "f" next to the corresponding defect number on the back of the piece control tag.
- I. As pieces loaded for shipment, precaster's Quality Control inspector shall reinspect pieces to verify completion of corrections and place and "x" after the letter "f" for each item verified and initial the piece for final approval. Pieces with uncorrected defects shall not be shipped.
- J. Defective Work: Precast concrete units that do not comply with requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete units that comply with requirements.

2.15 THIN BRICK UNITS AND ACCESSORIES

- A. Thin Brick Units: ASTM C 216, Type FBX or ASTM C 1088, Grade Exterior, Type TBX, not less than 1/2 inch thick with a tolerance of plus or minus 1/16 inch, and as follows:
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Manufacturer's Name (Architect to provide under separate cover.)
 - b. Product Name or Designation (Architect to provide under separate cover.)
 - 2. Face Size: 2-1/4 inches high by 7-1/2 to 7-5/8 inches long.

3. Special Shapes: Include corners, edge corners, and end edge corners.
 4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute; ASTM C 67.
 5. Efflorescence: Tested according to ASTM C 67 and rated "not effloresced."
- B. Place form liner templates accurately to provide grid for thin brick units. Provide solid backing and supports to maintain stability of liners while placing thin bricks and during concrete placement.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bearing Pads: Install bearing pads as precast concrete units are being erected. Set pads on true, level, and uniform bearing surfaces and maintain in correct position until precast concrete units are placed.
- B. Install precast structural concrete. Shore and brace precast concrete units to maintain location, stability, and alignment until permanent connections are installed.
- C. Welding: Perform welding in compliance with AWS D1.1 and AWS D1.4, with qualified welders.
1. Protect precast concrete units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.
 2. Repair damaged metal surfaces by cleaning and applying a coat of galvanized repair paint to galvanized surfaces.
- D. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units unless accepted by Engineer/Architect.
- E. Erection Tolerances: Install precast concrete units level, plumb, square, and true, and in alignment without exceeding the recommended erection tolerances of PCI MNL 127, "Recommended Practice for Erection of Precast Concrete." insert state below.
1. Structure shall be brought within tolerances and tolerances for deviation from plumb shall be checked by General Contractor-employed The State of North Carolina Registered Surveyor before placement of any cast-in-place concrete on superstructure.
 2. Variations between adjacent slab members shall comply with the requirements for walking surfaces in article "Field Quality Control."
- F. Grouting Connections and Joints: After precast concrete units have been placed and secured, grout open spaces at keyways, connections, and joints as follows:
1. Provide forms or other method to retain grout in place until hard enough to support itself. Where required, pack spaces with non-shrink, dry-pack grout material, tamping until voids

are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.

3.3 FIELD QUALITY CONTROL

- A. As pieces arrive at jobsite, General Contractor's Quality Control inspector shall check the production control tag for each piece to verify that the piece is complete and correct.
- B. Any defective Work that cannot be repaired to satisfaction of Engineer/Architect, whether found at site or at shop at any time before completion and acceptance of Project, will be rejected regardless of previous reviews and shall be remade or reconstructed to satisfaction of Engineer/Architect. However, finishes accepted at shop will not be rejected at site.
- C. Improperly located bearing pads or those of incorrect material will not be accepted by Engineer/Architect and shall be relocated or modified at expense of Contractor, no matter when rejected.
- D. Performance Requirements:
 - 1. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast pieces as required.
 - 2. Limitations as to amount of patching which will be permitted is subject to acceptance of Engineer/Architect.
 - 3. In-place precast pieces may be rejected for any 1 of following:
 - a. Exceeding specified installation tolerances.
 - b. Damaged during construction operations.
 - c. Exposed-to-view surfaces which develop surface finish deficiencies.
 - d. Other defects as listed in PCI MNL-116.
 - 4. Walking Surfaces: Walking areas subject to pedestrian traffic shall be slip resistant to meet minimum requirements in the specification Article "Quality Assurance".
 - 5. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with manufacturer's requirements. As a minimum, manufacturer requirements shall be submitted for record and address the procedures and materials specified in Division 07 Sections "Water Repellents" and "Concrete Joint Sealants." Receive Engineer's written acceptance of materials selected prior to application.
 - a. Repair isolated random horizontal cracks less than 0.01 in. wide, using silane sealer product specified in Division 7 "Water Repellents."
 - b. Repair isolated random horizontal cracks 0.01 in. to less than 0.03 in. wide, using methylmethacrylate or sikadur 55 SLV product specified in Division 07 "Water Repellents."
 - c. Repair isolated random horizontal cracks 0.03 in. to 0.06 in. wide: route and seal with specified sealant product in Division 7 "Concrete Joint Sealants."
 - d. Repair isolated random vertical cracks more than 0.01 in. wide, using epoxy injection product approved.
 - 6. Repairs and repaired pieces shall be subject to 5-year warranty provided by precaster. See Part 1 heading "Repair Warranty."

7. Repairs and repaired pieces shall have documented design. See Part 1 heading "Submittals."
- E. Welds and high-strength bolt connections are subject to inspection and testing by Testing Agency. As minimum, following testing shall be performed:
 1. Welds: Visually inspect all welds.
 - a. Double tee flange-to-flange connections: Test 5% of welds, if at discretion of Inspector, visual inspection inconclusive.
 - b. All other welds: Test 25% of all field fillet welds and 5% of all shop welds.
 - c. Testing: Penetrating dye or magnetic particle at Inspector discretion.
 - d. One spot test per partial penetration weld using magnetic or ultrasonic testing.
 2. Bolted Connections: Visual inspection of all connections. Check proper torque with calibrated torque wrench at minimum of 2 bolts of every connection.
- F. Testing Agency has authority to reject materials, welds, and connections not meeting Specifications.

3.4 CLEANING

- A. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains.
 1. Wash and rinse according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.
 3. At completion of Work or at such times as directed by Engineer/Architect, remove all rejected and surplus material, rubbish or apparatus from premises and deliver Work to Engineer/Architect's satisfaction.

END OF SECTION 034100

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SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Steel reinforcing bars.
 - 4. Masonry-joint reinforcement.
 - 5. Miscellaneous masonry accessories.
- B. Related Sections:
 - 1. Division 07 Section "Water Repellents", for water repellents applied to unit masonry assemblies.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Material Certificates: For each type and size of the following:

1. Masonry units.
2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver pre-blended, dry mortar mix in moisture-resistant containers. Store pre-blended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 2. Density Classification: Normal weight, unless otherwise indicated.
 3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

2.5 MASONRY LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Masonry Cement: ASTM C 91.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cemex S.A.B. de C.V.
 - b. Essroc.
 - c. Holcim (US) Inc.
 - d. Lafarge North America Inc.
 - e. Lehigh Hanson; Heidelberg Cement Group.

D. Mortar Cement: ASTM C 1329/C 1329M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Lafarge North America, Inc.

E. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

F. Cold-Weather Admixture: Non-chloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation-Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Grace Construction Products; W.R. Grace & Co. -- Conn.

G. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dur-O-Wal; a Hohmann & Barnard company.
 - b. Heckmann Building Products, Inc.
 - c. Hohmann & Barnard, Inc.
 - d. Wire-Bond.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82, with ASTM A 153, Class B-2 coating.
 2. Steel Plates, Shapes, and Bars: ASTM A 36.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size, and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.
 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For reinforced masonry, use Type N.
2. For mortar parge coats, use Type N.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.
4. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
 4. Verify that substrates are free of substances that would impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- F. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.8 LINTELS

- A. Provide concrete or masonry lintels where shown and where openings of more than 24 inches are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 REINFORCED UNIT MASONRY INSTALLATION

- A. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
 - 1. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
- C. Testing Prior to Construction: One set of tests.
- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- E. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.11 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.12 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

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SECTION 042613 - MASONRY VENEER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Clay face brick.
 - 2. Mortar.
 - 3. Embedded flashing.
 - 4. Miscellaneous masonry accessories.
- B. Products Installed but not Furnished under This Section:
 - 1. Steel lintels in masonry veneer.
 - 2. Steel shelf angles for supporting masonry veneer.
- C. Related Requirements:
 - 1. Section 042000 "Unit Masonry" for concrete unit masonry backup and accessories.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Verification: For each type and color of the following:
 - 1. Clay face brick, in the form of straps of five or more bricks.
 - 2. Special brick shapes.
 - 3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.

4. Weep holes and vents.
5. Accessories embedded in masonry.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. The work of this section shall be bid and performed by an experienced firm certified as a "North Carolina Masonry Contractors Association Certified Masonry Contractor" designated by the North Carolina Masonry Contractors Association Masonry Contractor Certification Program as a "CMP-Certified Masonry Professional" or "CME-Certified Masonry Executive" as described in the most current version of the NCMCA's "Guide to Masonry Contractors Certification." (North Carolina Masonry Contractors Association, PO Box 3463, Hickory, NC 28603-3463, (828) 324-1564, information@ncmca.com <<mailto:information@ncmca.com>>)
- C. The masonry subcontractor shall at all times when work is in progress, provide an individual from its own staff designated by the North Carolina Masonry Contractors Association Masonry Contractor Certification Program as a "CMP-Certified Masonry Professional" or "CME-Certified Masonry Executive" (as described in the most current version of the NCMCA's "Guide to Masonry Contractor Certification") on-site to supervise work in progress.
- D. The work shall be performed by a firm who specializes in masonry construction and shall furnish all materials, equipment, and labor required to complete the work (square foot/unit pricing of masonry labor and General Contractor furnished materials is not permitted.)
- E. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- F. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- G. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Build mockup of typical wall area as shown on Drawings.
 2. Build mockups for typical exterior wall in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness, including face and backup wythes and accessories.
 - a. Include a sealant-filled joint at least 16 inches (400 mm) long in [each] mockup.
 - b. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).
 3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
 4. Protect accepted mockups from the elements with weather-resistant membrane.

5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 1. Extend cover a minimum of 24 inches (600 mm) down face of veneer, and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.
 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.

2.3 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.

- B. Clay Face Brick: Facing brick complying with ASTM C216.
 - 1. Grade: SW.
 - 2. Type: FBS.
 - 3. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C7.
 - 4. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
 - 5. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
 - 6. Application: Use where brick is exposed unless otherwise indicated.
 - a. Color and Texture: Statesville Brick Company; "Red Royal Special".

2.4 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Colored Cement Product (Brick Veneer Mortar): Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
- E. Colored Portland Cement-Lime Mix:
 - 1. Mortar color shall be light grey. Basis of Design is masonry cement by Giant Cement Company in standard grey color to match existing mortar on campus.
 - 2. Mortar joint shall match existing on campus.
- F. Water: Potable.

2.5 EMBEDDED THROUGH-WALL FLASHING MATERIALS

- A. Flexible Flashing: Use the following unless otherwise indicated:
 - 1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Advanced Building Products Inc.: Peel-N-Seal.
 - 2) Carlisle Coatings & Waterproofing: CCW-705-TWF Thru-Wall Flashing.
 - 3) Dayton Superior Corporation, Dur-O-Wal Division: Dur-O-Barrier Thru-Wall Flashing.
 - 4) Fiberweb, Clark Hammerbeam Corp.: Aquaflash 500.
 - 5) Grace Construction Products, W. R. Grace & Co. - Conn.: Perm-A-Barrier Wall Flashing.
 - 6) Heckmann Building Products Inc.: No. 82 Rubberized-Asphalt Thru-Wall Flashing.
 - 7) Hohmann & Barnard, Inc.: Textroflash.
 - 8) W. R. Meadows, Inc.: Air-Shield Thru-Wall Flashing.
 - 9) Polyguard Products, Inc.: Polyguard 400.
 - 10) Sandell Manufacturing Co.: Inc.; Sando-Seal.
 - 11) Williams Products, Inc.: Everlastic MF-40.
 - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- B. Application: Unless otherwise indicated, use the following:
- 1. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 - 2. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
 - 3. Where flashing is fully concealed, use flexible flashing. Leading edge of flashing shall be left hanging beyond the face of the brick for trimming flush after installation is complete.
- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates. Provide continuous termination bar with sealant along top edge of flashing along sheathing and air barrier.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from urethane or PVC.
- B. Weep/Vent Products: Use the following unless otherwise indicated:
 - 1. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches (9 by 38 by 89 mm) long.

2.7 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
 - b. EaCo Chem, Inc.
 - c. PROSOCO, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
 - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
 - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

C. Joints:

1. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.
 - 1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
 - 1. For glazed masonry units, use a nonmetallic jointer 3/4 inch (19 mm) or more in width.

3.6 LINTELS

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.7 FLASHING, WEEP HOLES, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
 - 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 - 4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
 - 5. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.
 - 1. Use specified weep/vent products to form weep holes.
 - 2. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
 - 3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

- D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.8 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 4. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.9 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used and legally dispose of off Owner's property.

END OF SECTION 042613

SECTION 051617 - STRAND GUARDRAIL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following metal fabrications:
 - 1. Strand guardrail.
- B. Related Sections:
 - 1. Division 03 Section "Cast-in-Place Concrete"

1.3 SUBMITTALS

- A. Shop drawings detailing fabrication and installation of strand guardrail system. Include plans, elevations, sections, and details of fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts.
- B. Installation drawings shall include:
 - 1. Number, arrangement, and length of strand guardrails.
 - 2. Jacking force required to achieve specified final effective force for all strand guardrails.
 - 3. Cable elongations corresponding to jacking force and final effective force for all strand guardrails.
 - 4. Detailing of anchorage devices.
 - 5. Other incidental features.
- C. Submit following information with Installation Drawing submittal:
 - 1. Sealed calculations, prepared under supervision of a Professional Engineer licensed in North Carolina for jacking force required to achieve specified final effective strand pretension for all strand guardrails considering strand length, losses due to anchorage seating, and materials and equipment being supplied.
 - 2. Certified calibration curve for each jack to show the gauge pressure corresponding to the required jacking force.
- D. Qualification data for firms and persons specified in the "Quality Assurance" article to demonstrate their capabilities and experience. Include a list of completed projects with project name, addresses, names of architects and owners, and other information specified.
- E. Stressing records to Engineer/Architect promptly upon completion of stressing operations.

- F. Certification from Installer that stressing process and records have been reviewed, and that forces specified have been provided.
- G. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.
- H. Requests For Information
 - 1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
 - 2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 - 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in producing guardrail strand fabrications similar to those indicated for this Project with a record of successful in-service performance, and with sufficient production capacity to produce required units without delaying the Work.
- B. Provide barrier cable systems produced in PTI-certified plant conforming to all material and installation requirements of PTI "Specifications for Seven Wire Strand Barrier Cable Applications".
- C. Installer Qualifications: All barrier cable systems using seven-wire prestressing steel strands shall be installed by PTI certified installers.
- D. Work shall conform to requirements of PTI "Specifications for Seven Wire Strand Barrier Cable Applications", except where more stringent requirements are shown on Drawings or specified in this Section.
- E. Inspection Agency, employed by Owner shall keep barrier cable stressing records and submit to Engineer/Architect. Report will document:
 - 1. Calculated elongation, based upon actual elastic modulus and cross-sectional area of strands used.
 - 2. Actual field elongation measured for each guardrail strand.
 - 3. Gauge pressure required to achieve required jacking force [per calibration chart] for each strand.
 - 4. Actual gage pressures for each strand.
 - 5. Jack and gauge identification numbers.

1.5 REFERENCES

A. American Institute of Steel Construction (AISC):

1. AISC, "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC, "Manual of Steel Construction."
3. AISC, "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings."

B. American Society for Testing and Materials (ASTM):

1. ASTM A36, "Specification for Structural Steel."
2. ASTM A123, "Specification for Zinc (Hot-Dip Galvanized) Coatings On Iron and Steel Products."
3. ASTM A164, "Specification for Electrodeposited Coatings of Zinc on Steel."
4. ASTM A386, "Specification for Zinc Coating (Hot-Dip) on Assembled Steel Products."
5. ASTM A416, "Specification for Steel Strand, Uncoated Seven-Wire Stress-Relieved, for Prestressed Concrete."
6. ASTM A475, "Specification for Zinc-Coated Steel Wire Strand."
7. ASTM B454, "Specification for Mechanically Deposited Coatings of Cadmium and Zinc on Ferrous Metals."

C. Post-Tensioning Institute (PTI):

1. "Specification for Seven Wire Strand Barrier Cable Applications."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Check actual locations of walls and other construction to which strand guardrails must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 FERROUS METALS

- A. General: Comply with Post-Tensioning Institute's "Specification for Seven Wire Steel Strand Barrier Cable Applications."

B. Guardrail Strand and Prestressing/Post-Tensioning Anchors:

1. Seven wire, steel strand, 0.5 in. diameter, galvanized stress-relieved prestressing strand, with minimum ultimate tensile strength of 250,000 psi.
2. Strand to have continuous hot-dip galvanized coating. Minimum weight of zinc coating shall be 0.90 oz./sq. ft. (Class A).
3. Anchor bodies shall be galvanized and compatible with strand system furnished. Anchor bodies shall comply with Post-Tensioning Institute "Specification for Unbonded Single Strand Tendons." Environment: Corrosive. Repair damaged metal surfaces by cleaning and applying two coats of galvanizing repair paint to galvanized surfaces. Apply two coats of galvanizing repair paint to wedge grippers after stressing is complete.

4. Anchor back seating force. Unless noted otherwise, back seat all anchors to a force equal to 80% of the minimum ultimate tensile strength (MUTS) of the strand.

2.2 FABRICATION, GENERAL

- A. Form strand guardrail from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- B. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed strand guardrail assemblies to prevent over stressing. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
 1. Temperature Change (Range): 100 F°.
- C. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure strand guardrails rigidly in place and to support indicated loads.
- D. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- E. Fabricate joints that will be exposed to weather in a manner to exclude water.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchor bodies where necessary for securing miscellaneous metal fabrications to in-place construction.
- B. If the guardrail strands are required to be post-tensioned:
 1. Backstress all fixed and stressing anchorages.
 2. Stress, and then immediately backstress, individual guardrail strands one at a time.
 3. Backstress the guardrail strand to a force equal to 80% of the minimum ultimate tensile strength (MUTS) of the strand.
 4. Prevent damage to the column or other member to which the guardrail strand is anchored.
 5. For related procedures, refer to the PTI Guide Specification.

- C. Do not cut strand ends until Contractor receives Engineer/Architect's written approval of stressing records.

3.3 ADJUSTING AND CLEANING

- A. For galvanized surfaces, clean welds, bolted connections, and abraded areas, and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 051617

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Elevator hoist beams.
 - 4. Steel shapes for supporting elevator door sills.
 - 5. Metal ladders.
 - 6. Elevator pit sump covers.
 - 7. Pipe guards.
 - 8. Abrasive metal nosings.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Loose steel lintels.
 - 2. Anchor bolts or steel pipe sleeves, indicated to be cast into concrete or built into unit masonry.
 - 3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
- C. Related Sections:
 - 1. Division 03 Section "Cast-in-Place Concrete", for installing anchor bolts, steel pipe sleeves, and other items cast into concrete.
 - 2. Division 04 Section "Unit Masonry", for installing loose lintels, anchor bolts, and other items built into unit masonry.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Metal nosings.
 - 2. Paint products.
 - 3. Grout.
- B. Shop Drawings: Show fabrication and installation details. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Elevator hoist beams.
 - 4. Steel shapes for supporting elevator door sills.
 - 5. Metal ladders.
 - 6. Elevator pit sump covers.
 - 7. Pipe guards.
 - 8. Abrasive metal nosings.
 - 9. Loose steel lintels.
- C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner will in turn reimburse Engineer.
- E. Requests For Information:
 - 1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
 - 2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 - 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

- D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Rolled-Steel Floor Plate: ASTM A 786, rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D.
- F. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- G. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- H. Steel Pipe: ASTM A 53, Standard Weight (Schedule 40) unless otherwise indicated.
- I. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- J. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

- K. Aluminum-Alloy Rolled Tread Plate: ASTM B 632, Alloy 6061-T6.
- L. Aluminum Castings: ASTM B 26, Alloy 443.0-F.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- G. Post-Installed Anchors: Torque-controlled expansion anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

- A. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- F. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Section 033050 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch

hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 METAL LADDERS

- A. General: For elevator pit ladders, comply with ASME A17.1/CSA B44.

2.8 ELEVATOR PIT SUMP COVERS

- A. Fabricate from welded or pressure-locked steel bar grating Limit openings in gratings to no more than 3/4 inch in least dimension.
- B. Provide steel angle supports as indicated.

2.9 PIPE GUARDS

- A. Fabricate pipe guards from 3/8-inch thick by 12-inch wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch clearance between pipe and pipe guard. Drill each end for two 3/4-inch anchor bolts.
- B. Galvanize pipe guards.
- C. Prime pipe guards with zinc-rich primer.

2.10 ABRASIVE METAL NOSINGS

- A. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. Provide ribbed units, with abrasive filler strips projecting 1/16 inch above aluminum extrusion.
 2. Nosings: Square-back units, 3 inches wide, for casting into concrete steps.
 3. Nosings: Two-piece units, 3 inches wide, with subchannel for casting into concrete steps.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- C. Apply clear lacquer to concealed surfaces of extruded units.

2.11 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.12 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.13 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153 for steel and iron hardware and with ASTM A 123 for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

2.15 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for

use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for roll-up doors securely to, and rigidly brace from, building structure.

3.3 INSTALLING PIPE GUARDS

- A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

3.4 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

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SECTION 055010 – METAL PIPE BOLLARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal Pipe Bollards
 - 2. Bollard Sleeves
- B. Related Sections:
 - 1. Division 03 Section "Cast-in-Place Concrete"
 - a. For concrete pier surrounding bollard embedded below grade.
 - b. For installing anchor bolts into concrete.
 - c. For concrete placed in center of metal pipe bollard.
 - 2. Division 09 Section "Painting"

1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal pipe bollards and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Metal Pipe Bollards
 - 2. Bollard Sleeves

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- C. Steel Plates: ASTM A 36/A 36M.

2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use.
- B. Anchors, General: Anchors capable of sustaining, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- C. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.3 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- C. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form exposed work with accurate angles and surfaces and straight edges.
- D. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- E. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.5 METAL PIPE BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
 - 1. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 - 2. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. For bollards mounted on top of concrete slabs or curbs, fabricate bollards with 3/8-inch thick steel baseplates for bolting to concrete. Drill baseplates at all four corners for 3/4-inch anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Prime metal pipe bollards with zinc-rich primer.

2.6 REMOVEABLE BOLLARDS

- A. Prefabricated metal bollard with ground sleeve.
 - 1. Style to match existing removeable bollards current used on campus.
- B. Ground sleeve to have galvanized filler piece when bollard is not in use.
- C. Bollard and ground sleeve to have connection to allow Owner supplied lock to be installed.

2.7 BOLLARD SLEEVES

- A. "Ideal Shield", Detroit Michigan or Equivalent
- B. Materials:
 - 1. 1/4" Plastic Bollard Sleeve: Polyethylene Thermoplastic (HDPE) tubes having ultra-violet resistance and anti-static properties, nominal thickness 0.250 inches. Color shall be OSHA yellow unless otherwise noted. Size covers for pipe diameters.
- C. Bollard Sleeves:
 - 1. Provide original bumper post sleeves complying with the following requirements:
 - a. Dome top low-density polyethylene thermoplastic nominal thickness 0.250 inch.
 - b. Sleeve to shield 6" pipe diameter.
 - c. Sleeve Height: Custom
 - d. Sleeve Color: OSHA Yellow

- e. Surface of sleeve to be smooth with round top, no ribbed or two-piece systems accepted.
- f. Secure with manufacturer's neoprene adhesive tape; no screws, glue or clamping will be acceptable.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate installation of metal pipe bollards. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, and anchor bolts that are to be embedded in concrete. Deliver such items to Project site in time for installation.

3.2 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal bollards. Set metal pipe bollards accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where bollards are required to be fastened to in-place construction.

3.3 INSTALLING METAL PIPE BOLLARDS

- A. Anchor metal pipe bollards as shown on details.
- B. For bollards embedded below slab-on-grade, provide minimum 1'-6" diameter concrete pier that extends minimum 4'-3" below grade. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- C. For bollards attached to embedded metal plates, weld as noted and then provide primer over exposed metal.
- D. For bollards attached to concrete, install with (4) 3/4" diameter expansion or epoxy bolts.
- E. Where sign is to be placed at bollard as indicated on drawings, provide metal sign post placed in center of pipe bollard before filling pipe bollard with concrete.

F. Fill metal pipe bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.4 INSTALLING REMOVEABLE BOLLARDS

A. Comply with manufacturer provided instructions and drawings.

B. Ground sleeves should be installed with the top of the sleeve set flush with the finished surface.

C. Bollard should not be inserted into the ground sleeve until it is leveled and fully cured. Attach bollard per manufacturer instructions.

3.5 INSTALLING BOLLARD SLEEVES

A. Where indicated on drawings, provide bollard sleeves over metal pipe bollards.

B. Install with manufacturer's neoprene adhesive tape per manufacturers installation guidelines.

3.6 PAINTING METAL PIPE BOLLARDS

A. Where indicated on drawings, paint metal pipe bollards "Traffic Yellow".

END OF SECTION 055010

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SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel stair railings.
 - 2. Stainless-steel stair railings. (Alternate)

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Railing brackets.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of connecting and finishing members at intersections.
- D. Delegated-Design Submittal: For railings indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by a qualified professional engineer currently licensed in North Carolina responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Design railing assemblies, wall rails and attachments in strict accordance with the North Carolina State Building Code, 2012, Section 1607.7. Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C, material surfaces).

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.3 STEEL AND IRON

- A. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish.
- B. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Guards:
 - 1. Rails: Round pipe.
 - a. Outside Diameter: As indicated on the Drawings.
 - 2. Infill at Picket Railings: Vertical pickets.
 - a. Horizontal Spacing: Maximum 4 inches (100 mm) on center.
 - b. Material: Steel tube.
 - c. Shape: Square.
 - d. Size: 3/4 inch (18 mm) square.
 - e. Top Mounting: Welded to underside of top rail.
 - f. Bottom Mounting: Welded to top surface of stringer.
 - 3. Other Infill at Pipe Railings:
 - a. Outside Diameter: 1 inch (25 mm).
 - b. Material: Steel pipe.
 - c. Vertical Spacing: Maximum 4 inches (100 mm) on center.
 - d. Jointing: Welded and ground smooth and flush.
 - 4. End and Intermediate Posts: Same material and size as top rails.
 - a. Horizontal Spacing: As indicated on drawings.
 - b. Mounting: Welded to top surface of stringer.

2.4 STAINLESS STEEL RAILINGS (ALTERNATE)

- A. Pipe: ASTM A 312/A 312M, Grade TP 304.
- B. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
- C. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Guards:
 - 1. Rails: Stainless steel round pipe.
 - a. Outside Diameter: As indicated on the Drawings.
 - 2. Infill at Picket Railings: Vertical pickets.
 - a. Horizontal Spacing: Maximum 4 inches (100 mm) on center.
 - b. Material: Stainless steel tube.
 - c. Shape: Square.
 - d. Size: 3/4 inch (18 mm) square.
 - e. Top Mounting: Welded to underside of top rail.
 - f. Bottom Mounting: Welded to top surface of stringer.
 - 3. Other Infill at Pipe Railings:
 - a. Outside Diameter: 1 inch (25 mm).
 - b. Material: Steel pipe.
 - c. Vertical Spacing: Maximum 4 inches (100 mm) on center.
 - d. Jointing: Welded and ground smooth and flush.
 - 4. End and Intermediate Posts: Same material and size as top rails.
 - a. Horizontal Spacing: As indicated on drawings.
 - b. Mounting: Welded to top surface of stringer.

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 2. Stainless-Steel Railings: Type 304 stainless-steel fasteners.
 - 3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. Form Changes in Direction as Follows:
 - 1. As detailed.
- K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members with prefabricated end fittings.
- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.8 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize steel railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - 4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
 1. Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2.9 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. Dull Satin Finish: No. 6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.
- B. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.6 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055213

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall sheathing.
 - 2. Roof sheathing.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

- A. Plywood: DOC PS 1, 3/4 inch unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all plywood unless otherwise indicated.

2.3 WALL SHEATHING

- A. Plywood Wall Sheathing: Interior plywood as specified herein.

2.4 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exterior sheathing as specified herein.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof sheathing, provide fasteners of Type 304 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

3.2 WOOD PANEL INSTALLATION

- A. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Screw to substrate.
 - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

END OF SECTION 061600

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Modified bituminous sheet waterproofing.
 - 2. Modified bituminous sheet waterproofing, fabric reinforced.
- B. Related Sections:
 - 1. Division 03 Section "Cast-in-Place Concrete"

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 - 1. Warranty Period: [Three] [Five] <Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side.
 - 1. Manufacturer/Product:
 - a. W.R. Meadows: Mel-Rol
 - b. Polyguard: 650 Sheet Membrane
 - c. CETCO: Envirosheet
 - d. Carlisle: Miradri 860/861
 - e. Or Equivalent.
 - 2. Physical Properties:
 - a. Tensile Strength, Membrane: 250 psi minimum; ASTM D412, Die C, modified.
 - b. Ultimate Elongation: 300 percent minimum; ASTM D412, Die C, modified.
 - c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
 - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C836/C836M.
 - e. Puncture Resistance: 40 lbf minimum; ASTM E154/E154M.

- f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
 - g. Water Vapor Permeance: 0.05 perm maximum; ASTM E96/E96M, Water Method.
 - 3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.
- B. Modified Bituminous Sheet, Fabric Reinforced: Minimum 60-mil nominal thickness, self-adhering sheet consisting of rubberized-asphalt membrane with embedded fabric reinforcement, and with release liner on adhesive side.
 - 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
 - 2. Physical Properties:
 - a. Pliability: No cracks when bent 180 degrees over a 1-inch mandrel at minus 25 deg F; ASTM D146/D146M.
 - b. Puncture Resistance: 40 lbf minimum; ASTM E154/E154M.
 - c. Water Vapor Permeance: 0.05 perm maximum; ASTM E96/E96M, Water Method.
 - 3. Sheet Strips: Self-adhering, reinforced, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 - 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- C. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- D. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- E. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.

2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D4258.
 1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- F. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D6135.
 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
- G. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D6135.

3.3 INSTALLATION OF MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and per recommendations in ASTM D6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

- D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- E. Seal edges of sheet-waterproofing terminations with mastic.
- F. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.
- G. Immediately install protection course with butted joints over waterproofing membrane.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests.
- B. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.
- C. Waterproofing will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 PROTECTION, REPAIR, AND CLEANING

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071326

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SECTION 071800 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Traffic Coating – Fluid-applied waterproofing consisting of a traffic-bearing elastomeric membrane with integral wearing surface, where surface to which membrane is to be applied is one or more of following:
 - a. Over occupied space and enclosed rooms.
- B. A single installer shall be responsible for providing complete water proofing system including all products specified in following Sections:
 - 1. Division 07 Section “Traffic Coatings”
 - 2. Division 07 Section “Water Repellents”
 - 3. Division 07 Section “Concrete Joint Sealants”
 - 4. Division 07 Section “Expansion Joint Assemblies”
- C. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
- D. Related Sections:
 - 1. Division 03 Section “Cast-in-Place Concrete”
 - 2. Division 03 Section “Precast Concrete”
 - 3. Division 07 Section “Water Repellents”
 - 4. Division 07 Section “Concrete Joint Sealants”
 - 5. Division 07 Section “Expansion Joint Assemblies”
 - 6. Division 09 Section “Pavement Markings”

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Distribute reviewed submittals to all others whose Work is related.
 - 2. Materials shall be compatible with materials or related work with which they come into contact, and with materials covered by this section.

- B. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.
- C. Requests For Information
 - 1. Engineer reserves right to reject, unprocessed, any Request for Information (RFI) that Engineer, at its sole discretion, deems frivolous and/or deems already answered in the Contract Documents.
 - 2. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in Contract documents.

1.4 ACTION SUBMITTALS

- A. Product Data: For each system indicated, submit the following at least 60 days prior to application.
 - 1. Product description, technical data, appropriate applications, and limitations.
 - 2. Primer type and application rate.
 - 3. Material and wet mils required to obtain specified dry thickness for each coat.
 - 4. Type, gradation, and aggregate loading required within each coat.
- B. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

- A. Certificates
 - 1. Certification that products and installation comply with applicable federal, North Carolina, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
 - 2. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.
 - 3. Certification from Manufacturer that finishes as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive traffic coating.
 - 4. Certification stating static coefficient of friction meets minimum requirements of Americans with Disabilities Act (ADA).
 - 5. Certification stating materials have been tested and listed for UL 790 Class "A" rated materials/system by UL for traffic coating application specified on project. Containers shall bear UL labels.
 - 6. Certification from manufacturer confirming compatibility with existing underlying coatings and/or substrate.
- B. Manufacturer's Instructions: For each system indicated.

1. Crack treatment and surface preparation method and acceptance criteria.
2. Method of application of each coat.
3. Maximum and minimum allowable times between coats.
4. Final cure time before resumption of parking and/or paint striping.
5. Any other special instructions required to ensure proper installation.

C. Field Quality Control:

1. Quality Control Plan as defined in Part 3.
2. Two copies each of manufacturer's technical representative's log for each visit.
3. Testing agency field reports.

D. Qualification Statements

1. Manufacturer's qualifications as defined in "Quality Assurance" article.
2. Installer's qualifications as defined in "Quality Assurance" article.
3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Three copies of System Maintenance Manual.
- B. Final executed Warranty.

1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.
 1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
 2. Evidence of financial stability acceptable to Engineer/Architect.
 3. Listing of 20 or more projects completed with submitted system, to include:
 - a. Name and location of project.
 - b. Type of system applied.
 - c. On-Site contact with phone number.
- B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.
- C. Installer's Qualifications: Owner retains right to reject any manufacturer.
 1. Evidence of compliance with Summary article paragraph "A single installer. . ."
 2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
 3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.
- D. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.

E. Certifications

1. Traffic coating shall satisfy current National Volatile Organic Compound (VOC) Emission Standards for Architectural Coatings.
2. Licensing/certification document from manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in North Carolina.
3. Licensing/certification agreement shall include following information:
 - a. Applicator's financial responsibility for warranty burden under agreement terms.
 - b. Manufacturer's financial responsibility for warranty burden under agreement terms.
 - c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
 - d. Authorized signatures for both Applicator Company and Manufacturer.
 - e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
1. Name of product.
 2. Name of manufacturer.
 3. Date of preparation.
 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

1.9 FIELD CONDITIONS

- A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

- A. System Manufacturer: Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and applicator with regard to warranty requirements (Joint and Several). Warranty shall provide that system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:
1. Any adhesive or cohesive failures.
 2. Spalling surfaces.
 3. Weathering.
 4. Surface crazing (does not apply to traffic coating protection course).
 5. Abrasion or tear failure resulting from normal traffic use.
 6. Failure to bridge cracks less than 0.0625 in. or cracks existing at time of traffic coating installation on double tees only.

- B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.
- C. Warranty period shall be a 5-year Joint and Several Warranty commencing with date of acceptance of work.
- D. Perform any repair under this warranty at no cost to Owner.
- E. Address following in terms of Warranty: length of warranty, change in value of warranty - if any - based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of following, only where specifically named in product category:
 - 1. Advanced Polymer Technology (APT), Harmony, PA
 - 2. BASF Building Systems (BASF), Shakopee, MN
 - 3. Deneef Construction Chemicals (Deneef), Houston, TX
 - 4. Lymtal International Inc. (Lymtal), Lake Orion, MI
 - 5. Neogard Division of Jones-Blair Company (Neogard), Dallas, TX
 - 6. Pacific Polymers, Inc. a Division of ITW (Pacific Polymers), Garden Grove, CA
 - 7. Sika Corporation (Sika), Lyndhurst, NJ
 - 8. Tremco (Tremco), Cleveland, OH

2.2 MATERIALS, TRAFFIC COATING

- A. Acceptable coatings are listed below. One will be selected as an alternate. In bid form, list bid price for each coating listed below. Contract for coating will not necessarily be directed to lowest bid priced coating. Coatings shall be compatible with all other materials in this Section and related work.
 - 1. Heavy Duty:
 - a. Autogard HD-48, Autogard E, Neogard.
 - b. Elasto-Deck 5000-HT, Pacific Polymers.
 - c. Iso-Flex 750U-HL HVT/760U-HL HVT Deck Coating System, LymTal.
 - d. MasterSeal Traffic 1500, BASF.
 - e. Qualideck Heavy Vehicular (152/252/372/512), APT.
 - f. Sikalastic 710/715, Sika.
 - g. Vulkem 350/345/346/346 Deck Coating System, Tremco.
- B. Provide ultraviolet screening for all traffic coating placed on this project.
- C. Finish top coat shall be colored grey.

- D. Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

2.3 MATERIALS, CRACK SEALER

- A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:
1. Denedeck Crack Sealer, Deneef.
 2. Iso-Flex 609 Epoxy Crack Sealer, Lyntal.
 3. MasterSeal 630, BASF.
 4. Sikadur 55 SLV Epoxy Crack Healer/Sealer, Sika.
 5. SikaPronto 19TF, Sika.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.
- B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:
1. Concrete surfaces are finished as acceptable for system to be installed. Correct all high points, ridges, and other defects in a manner acceptable to Engineer/Architect.
 2. Curing compounds used on concrete surfaces are compatible with system to be installed.
 3. Concrete surfaces have completed proper curing period for system selected.
 4. Joint Sealants are compatible with traffic coatings.
 5. Joint Sealants are flush, not concave.

3.2 PREPARATION

- A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.
- B. Acid etching is prohibited.
- C. Remove all laitance and surface contaminants, including oil, grease, and dirt as specified by manufacturer's written recommendations.
- D. Before applying materials, apply system to small area to assure that it will adhere to substrate and joint sealants, and dry properly, and to evaluate appearance.
- E. All cracks on concrete surface shall be prepared in accordance with manufacturer's recommendations.

- F. Mask off adjoining surfaces not to receive traffic coating and mask off drains to prevent spillage and migration of liquid materials outside membrane area. Provide neat/straight lines at termination of traffic coating.

3.3 INSTALLATION/APPLICATION

- A. Installation should include all of the following steps:
 - 1. Surface Preparation: Prepare concrete for system application.
 - 2. Crack/Construction/Control/Cove Joint Sealing: Detail for crack bridging.
 - 3. Primer Coat: Insure proper adhesion of membrane to substrate.
 - 4. Base Coat: Provide crack spanning in conjunction with Crack Detail noted above.
 - 5. Aggregate Coat – to hold aggregate in system, providing skid and wear close up resistance.
 - 6. Aggregate: Correct size, shape, hardness and amount necessary to insure proper skid and wear resistance.
 - 7. Top Coat: Lock aggregate into place, provide a maintainable surface and provide resistance to ponding water, UV degradation, color loss, and chemical intrusion.
- B. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverages, mil thicknesses, and texture, and as shown on Drawings.
- C. A primer coat is required for all systems. No exception.
- D. Do not apply traffic coating material until concrete has been air dried at temperatures at or above 40°F for at least 30 days after curing period specified.
- E. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40°F.
- F. All adjacent vertical surfaces shall be coated with traffic coating minimum of 4 in. above coated horizontal surface. Requirement includes, but is not limited to pipes, columns, walls, curbs (full height of vertical faces of all curbs) and islands.
- G. Complete all Work under this Section before painting line stripes.
- H. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

3.4 FIELD QUALITY CONTROL

- A. Develop a quality control plan for assured specified uniform membrane thickness that utilizes grid system of sufficiently small size to designate coverage area of not more than 5 gallons at specified thickness. In addition, employ wet mil gauge to continuously monitor thickness during application. Average specified wet mil thickness shall be maintained within grid during application with minimum thickness of not less than 80% of average acceptable thickness. Immediately apply more material to any area not maintaining these standards.

- B. Testing Agency employ wet mil gauge to periodically monitor thickness during application.
- C. Install 1 trial section of coating system. Do not proceed with further coating application until trial sections accepted in writing by Engineer/Architect. Remove and replace rejected trial sections with acceptable application. Trial section shall also be tested for:
 - 1. Wet mil thickness application.
 - 2. Adhesion to concrete substrate.
 - 3. Overall dry mil thickness.

END OF SECTION 071800

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SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes Penetrating Concrete Sealer on these surfaces:
 - 1. The entire floor surface on Level 5.
 - 2. The floor surface on the ramp down from Level 5 to Level 4.
 - 3. For different sizes of concrete cracks on other levels.
- B. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:
 - 1. Division 07 Section "Traffic Coatings"
 - 2. Division 07 Section "Water Repellents"
 - 3. Division 07 Section "Concrete Joint Sealants"
 - 4. Division 07 Section "Expansion Joint Assemblies"
- C. Related Sections:
 - 1. Division 03 Section "Cast-in-Place Concrete"
 - 2. Division 03 Section "Precast Concrete"
 - 3. Division 07 Section "Traffic Coatings"
 - 4. Division 07 Section "Concrete Joint Sealants"
 - 5. Division 07 Section "Expansion Joint Assemblies"
 - 6. Division 09 Section "Pavement Markings"

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D6489, "Standard Test Method for Determining the Water Absorption of Hardened Concrete Treated with a Water Repellent Coating."

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.

2. Distribute reviewed submittals to all others whose Work is related.

B. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.

C. Requests For Information

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated at least 60 days prior to application.

1. Product description, technical data, appropriate applications, and limitations.
2. Areas and application rates of materials to be applied.
3. Proposed alternate application methods, if any.

1.6 INFORMATION SUBMITTALS

A. Certificates

1. Certification that products and installation comply with applicable federal, state of North Carolina and local EPA, OSHA and VOC requirements regarding health and safety hazards.
2. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.

B. Field Quality Control

1. ASTM D6489 Test Results
2. Two copies of manufacturer's technical representative's log for each visit.

C. Qualification Statements

1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.
 - 1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
 - 2. Evidence of financial stability acceptable to Engineer/Architect.
 - 3. Listing of 20 or more projects completed with submitted system, to include:
 - a. Name and location of project.
 - b. Type of system applied.
 - c. On-Site contact with phone number.
- B. Installer's Qualifications: Owner retains right to reject any installer.
 - 1. Evidence of compliance with Summary article paragraph "A single installer. . ."
 - 2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
 - 3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.
- C. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.
- D. Certifications
 - 1. Sealer shall satisfy the current national and local Volatile Organic Compound (VOC) Emission Standards for Architectural Coatings.
 - 2. Licensing/certification document from system manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of North Carolina.
 - 3. Licensing/certification agreement must provide following information:
 - a. Applicator's financial responsibility for warranty burden under agreement terms.
 - b. Manufacturer's financial responsibility for warranty burden under agreement terms.
 - c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
 - d. Officers' signatures for both Applicator Company and Manufacturer.
 - e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
 - 1. Name of product.
 - 2. Name of manufacturer.
 - 3. Date of preparation.
 - 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

1.9 FIELD CONDITIONS

- A. Weather and Substrate Conditions: Do not proceed with application (except with written recommendation of manufacturer) under any of the following conditions:
1. Ambient temperature is less than 40° F.
 2. Substrate surfaces have cured for less than 1 month.
 3. Rain or temperatures below 40° F predicted for a period of 24 hours.
 4. Less than 24 hours after surfaces became wet.
 5. Substrate is frozen or surface temperature is less than 40° F.
 6. Wind velocities higher than manufacturer's specified limit to prevent solvent flash-off.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of following, only where specifically named in product category:
1. Advanced Chemical Technologies Inc. (ACT), Oklahoma City, OK.
 2. BASF Building Systems (BASF), Shakopee, MN.
 3. Deneef Construction Chemicals (Deneef), Houston, TX.
 4. Evonik Degussa Corporation (Evonik Degussa), Parsippany, NJ.
 5. Euclid Chemical Company (Euclid), Cleveland, OH.
 6. Lymtal International Inc. (Lymtal), Lake Orion, MI.
 7. Sika Corporation (Sika), Lyndhurst, NJ.

2.2 MATERIALS, CRACK SEALER

- A. Repair for isolated random horizontal cracks less than 0.01 in. wide. Acceptable products:
1. MasterProtect H 440 HZ, 125 sf/g, BASF.
 2. Iso-flex 618-40 VOC, 125sf/g, Lymtal.
 3. Protectosil Chem-Trete 40 VOC, 125 sf/g, Evonik Degussa.
 4. Sikagard 740W ,125 sf/g, Sika.
 5. Sil-Act ATS-42, 125 sf/g, ACT.

2.3 MATERIALS, CRACK SEALER

- A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:
1. SikaPronto 19TF, Sika.
 2. Sikadur 55 SLV Epoxy Crack Healer/Sealer, Sika.
 3. MasterSeal 630, BASF.
 4. Denedeck Crack Sealer, Deneef.
 5. Iso-Flex 609 Epoxy Crack Sealer, Lymtal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.
- B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:
 - 1. Concrete surface finishes are acceptable for system to be installed.
 - 2. Curing compounds used on concrete surfaces are compatible with system to be installed.
 - 3. Concrete surfaces have completed proper curing period for system selected.
 - 4. Control joint and expansion joint Work is complete and has been accepted by Engineer/Architect.

3.2 PREPARATION

- A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.
- B. Acid etching is prohibited.
- C. Repair or replace all sealant materials damaged by surface preparation operations.
- D. Clean all surfaces to be sealed by high pressure washer spray as acceptable to sealer manufacturer before sealer application. Shot blasting will be required for new slabs that are not water cured per ACI 308, Paragraph 2.2. Cleaning method and materials shall be sufficient to allow absorption criteria stated in Field Quality Control article to be met. Equipment used during floor slab cleaning shall not exceed height limitation of facility and shall not exceed 3,000 lb axle load or vehicle gross weight of 6,000 lb.
- E. Mask off adjoining surfaces not to receive sealer and mask off drains to prevent spillage and migration of liquid materials outside sealer area. Provide neat/straight lines at termination of sealer.

3.3 INSTALLATION/APPLICATION

- A. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverage, mil thickness, and texture, and as shown on Drawings.
- B. Clean all surfaces affected by sealer material overspray and repair all damage caused by sealer material overspray to adjacent construction or property at no cost to Owner.
- C. Clean off excess material as work progresses using methods and materials approved by manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Install 3 trial sections of sealer to verify treated surface is not glazing as result of sealer application. If application of sealer causes glazing at trial section, contact sealer manufacturer to obtain written recommendations for solving problem. Do not proceed with sealer application following trial section applications until directed to do so in writing by Engineer/Architect.

3.5 NON-CONFORMING WORK

- A. Unsatisfactory Field Quality Control test results shall be grounds for rejection of sealer or sealer application rate. Perform sealer reapplication at no additional cost to Owner.

END OF SECTION 071900

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.

1. Classifications:

a. Type II:

- 1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.

- 2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
 - 3) Thermal Resistance, R-value (RSI-value): At 1-1/2 inch (38.1 mm) thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F (24 degrees C).
2. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
 3. Board Thickness: 2.0 inch (50 mm).
 4. Board Edges: Square.
 5. Manufacturers:
 - a. Carlisle Coatings & Waterproofing, Inc; R2+ Matte: www.carlisleccw.com/#sle.
 - b. Dow Chemical Company; THERMAX (ci): www.dowbuildingsolutions.com/#sle.
 - c. Hunter Panels; Xci CG: www.hunterpanels.com/#sle.
- B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation[or vapor retarders, including removing projections capable of puncturing vapor retarders,] or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

3.4 PROTECTION

- A. Protect installed insulation from damage due to physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Foamed-in-place insulation.
 - 1. In masonry walls.

1.2 SUBMITTALS

- A. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- B. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.

1.3 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide insulating materials which comply with requirements indicated for materials, compliance with referenced standards, and other characteristics.
- B. Foamed-In-Place Masonry Insulation: Two component thermal insulation produced by combining a plastic resin and catalyst foaming agent surfactant which, when properly ratioed and mixed, together with compressed air produce a cold-setting foam insulation in the hollow cores of hollow unit masonry walls.
 - 1. Surface Burning Characteristics: Maximum flame spread, smoke developed and fuel contributed of 0, 5 and 0 respectively.
 - 2. Combustion Characteristics: Must be noncombustible, Class A building material.
 - 3. Thermal Values: "R" Value of 4.84/inch @ 35 degrees F mean; ASTM C-518.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify work within construction spaces is complete prior to insulation application.

3.2 APPLICATION

- A. General: Install foamed-in-place insulation from interior, or as specified, prior to installation of interior finish work and after all masonry and structural concrete work is in place; comply with manufacturer's instructions.
- B. Installation at Regular Block Walls: Fill all open cells and voids in hollow concrete masonry walls where shown on drawings. The foam insulation shall be pressure injected through a series of small holes in the mortar until the cavities are filled in accordance with manufacturer's instructions. Fill all cells completely with insulation.

END OF SECTION 072119

SECTION 073113 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Asphalt shingles.
- B. Underlayments.
- C. Related Sections:
 - 1. Section 061600 "Sheathing" for roof sheathing.
 - 2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof penetration flashings.

1.2 DEFINITION

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of asphalt shingle ridge and hip cap shingles and exposed valley lining indicated.
 - 1. Include similar Samples of trim and accessories involving color selection.
- C. Samples for Verification: For the following products, of sizes indicated, to verify color selected:
 - 1. Asphalt Shingle: Full size.
 - 2. Ridge and Hip Cap Shingles: Full size.
 - 3. Self-Adhering Underlayment: 12 inches (300 mm) square.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for asphalt shingles.
- C. Research/Evaluation Reports: For each type of asphalt shingle required, from the ICC.
- D. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of asphalt shingle to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Asphalt Shingles: 100 sq. ft (9.3 sq. m) of each type, in unbroken bundles.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain ridge and hip cap shingles from single source from single manufacturer.
- C. Fire-Resistance Characteristics: Where indicated, provide asphalt shingles and related roofing materials identical to those of assemblies tested for fire resistance per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
 - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108 or UL 790, for application and roof slopes indicated.
- D. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store roofing materials in a dry, well-ventilated, weathertight location according to asphalt shingle manufacturer's written instructions. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.
 - 1. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.
- B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install asphalt shingles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by manufacturer.

1.10 WARRANTY

- A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Manufacturing defects.
 - b. Structural failures including failure of asphalt shingles to self-seal after a reasonable time.
 - 2. Material Warranty Period: Manufacturer's 40 Year Prorated Warranty from date of Final Acceptance.
 - 3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds up to 130 mph (6 nail pattern) 10 years from date of Final Acceptance.
 - 4. Algae-Discoloration Warranty Period: Asphalt shingles will not discolor 10 years from date of Final Acceptance.
- B. Special Project Warranty: Roofing Installer's Warranty, or warranty form at end of this Section, signed by roofing Installer, covering the Work of this Section, in which roofing Installer agrees to repair or replace components of asphalt shingle roofing that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Laminated-Strip Asphalt Shingles: ASTM D 3462, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: GAF Timberline Ultra Shingles or comparable product by one of the following:
 - a. Atlas Roofing Corporation.
 - b. CertainTeed Corporation.
 - c. Elk Premium Building Products, Inc.; an Elk Corp company.
 - d. Owens Corning.
 - 3. Butt Edge: Straight cut.
 - 4. Strip Size: Manufacturer's standard.
 - 5. Algae Resistance: Granules treated to resist algae discoloration.
 - 6. Color and Blends: As selected by Architect from manufacturer's full range.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering Sheet Underlayment: ASTM D 1970, minimum of 40-mil- (1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Ice and Water Shield manufactured by Grace Building Products or comparable product by one of the following:
 - a. Carlisle Coatings & Waterproofing, Inc.
 - b. Henry Company.
 - c. Johns Manville.
 - d. Owens Corning.
 - e. Polyguard Products, Inc.
 - f. Protecto Wrap Company.

2.3 RIDGE VENTS

- A. Rigid Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent with nonwoven geotextile filter strips and external deflector baffles; for use under ridge shingles.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Shingle Vent II manufactured by Air Vent Inc. or comparable product by one of the following:
 - a. Air Vent, Inc.; a Gibraltar Industries company.
 - b. Cor-A-Vent, Inc.
 - c. GAF Materials Corporation.
 - d. Owens Corning.
 - e. RGM Products, Inc.
 - f. Trimline Building Products.
 - 3. Minimum Net Free Area: 12 inches per linear foot.
 - 4. Width: 12 inches.

2.4 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

- B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- (3-mm-) diameter, barbed shank, sharp-pointed, with a minimum 3/8-inch- (9.5-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through OSB or plywood sheathing.
 - 1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

2.5 METAL FLASHING AND TRIM

- A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provision has been made for flashings and penetrations through asphalt shingles.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated, lapped in direction to shed water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

3.3 METAL FLASHING INSTALLATION

- A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
 - 1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

- B. Rake Drip Edges: Install rake drip edge flashings over underlayment and fasten to roof deck.
- C. Eave Drip Edges: Install eave drip edge flashings below underlayment and fasten to roof sheathing.

3.4 ASPHALT SHINGLE INSTALLATION

- A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."
- B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with tabs removed at least 7 inches (175 mm) wide with self-sealing strip face up at roof edge.
 - 1. Extend asphalt shingles 1/2 inch (13 mm) over fasciae at eaves and rakes.
 - 2. Install starter strip along rake edge.
- C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- E. Install asphalt shingles by single-strip column or racking method, maintaining uniform exposure. Install full-length first course followed by cut second course, repeating alternating pattern in succeeding courses.
- F. Fasten asphalt shingle strips with a minimum of five roofing nails located according to manufacturer's written instructions.
 - 1. Where roof slope exceeds 20:12, seal asphalt shingles with asphalt roofing cement spots after fastening with additional roofing nails.
 - 2. When ambient temperature during installation is below 50 deg F (10 deg C), seal asphalt shingles with asphalt roofing cement spots.
- G. Ridge and Hip Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.
 - 1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION 073113

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formed roof-drainage sheet metal fabrications.
 - 2. Formed steep-slope roof sheet metal fabrications.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for roof sheathing.

1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Samples for Verification: For each type of exposed finish.
 - 1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
 - 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color: As selected by Architect from manufacturer's full range.
 - 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.3 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- G. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.
- H. Do not use graphite pencils to mark metal surfaces.

2.4 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
 - 1. Gutter Profile: As indicated.
 - 2. Expansion Joints: Lap type.
 - 3. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.
 - 4. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:
 - a. Aluminum: 0.040 inch.
- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.
 - 1. Hanger Style: As indicated.
 - 2. Fabricate from the following materials:
 - a. Aluminum: 0.032 inch (0.76 mm) thick.
- C. Splash Pans: Fabricate to dimensions and shape required and from the following materials:
 - 1. Aluminum: 0.040 inch (1.02 mm).

2.5 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Drip Edges: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch (0.81 mm).
- B. Eave, Rake Flashing: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch (0.81 mm).
- C. Counterflashing: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch (0.81 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners[, solder], protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 5. Torch cutting of sheet metal flashing and trim is not permitted.
 - 6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 - 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

3.3 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
 - 1. Fasten gutter spacers to front and back of gutter.
 - 2. Anchor gutter with straps spaced not more than 24 inches (600 mm) apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
 - 3. Install gutter with expansion joints not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
 - 4. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.
- C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.
 - 1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
 - 2. Provide elbows at base of downspout to direct water away from building.
- D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in elastomeric sealant compatible with the substrate.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 079200 - JOINT SEALERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Sealants and joint backing.
- B. Precompressed foam sealers.

1.2 RELATED REQUIREMENTS

- A. Section 088000 - Glazing: Glazing sealants and accessories.

1.3 REFERENCE STANDARDS

- A. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- B. ASTM D1667 - Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell).

1.4 SUBMITTALS

- A. Product Data: Provide data indicating sealant chemical characteristics.
- B. Caulking Schedule: The Contractor, together with the manufacturer's selected from those specified, shall prepare a detailed schedule of caulking and sealing work. For all conditions, the schedule shall indicated joint function; materials forming the joint together with cleaning, preparation, and backing requirements; priming requirements; sequence and timing of caulking and sealing operations showing maximum allowable time joints may be exposed before sealing, minimum and maximum allowable time intervals between successive steps in sealing operations, and governing weather conditions including temperature, humidity, wind, etc., and requirements for storage and preconditioning of materials.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years experience.
- C. Pre-construction Compatibility and Adhesion Testing:
 - 1. Submit to joint sealant manufacturer samples of actual production materials that will contact or affect their joint sealants in the Work for compatibility as per ASTM C-1087 and adhesion testing per ASTM C-794.
 - 2. This testing will not be required where sealant manufacturer is able to furnish data acceptable to Architect based on previous testing for adhesion and compatibility to materials matching those of the Work.

D. Pre-construction Field Adhesion Testing:

1. In jobsite field samples prior to general installation, conduct field-tests for adhesion of joint sealants to actual joint substrates using proposed joint preparation methods recommended by manufacturer.
2. Conduct tests for each type of sealant and substrate.
3. Locate field-test joints where inconspicuous or as approved by Architect.
 - a. Include areas typical of those requiring removal of existing sealants and utilize methods proposed for sealant removal that have been pre-approved by Architect.
4. Test method: Use manufacturer's standard field adhesion test methods and methods proposed for joint preparation to verify proper priming and joint preparation techniques required to obtain optimum adhesion of joint sealants to joint substrate.
5. Evaluate and report results of field adhesion testing.
6. Do not use joint preparation methods or sealants that produce less than satisfactory adhesion to joint substrates during testing.

1.6 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation. Install in dry weather or conditions favorable for curing.

1.7 COORDINATION

- A. Coordinate the work with all sections referencing this section.

1.8 WARRANTY

- A. Correct defective work within a five year period after Date of Final Acceptance.
- B. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Polyurethane Sealants:
 1. Bostik.
 2. Pecora Corp. (Basis of Design)
 3. Tremco, A BFGoodrich Specialty Chemicals Company.

B. Preformed Compressible Foam Sealers:

1. EMSEAL Joint Systems, Ltd.; Product Emseal 25V: www.emseal.com.
2. Sandell Manufacturing Company, Inc.; Product Polyseal: www.sandellmfg.com.
3. Willseal USA, LLC: Product Willseal 150: www.willsealusa.com

2.2 SEALANTS

A. General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Grade NS, Class 25, Uses M, G, and A; single component.

1. Color: Standard colors matching finished surfaces.
2. Product: DynaTrol I-XL manufactured by Pecora or approved equal.
3. Applications: Use for:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.

2.3 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.

- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.
- H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch (3 to 6 mm) below adjoining surface.

3.4 CLEANING

- A. Clean adjacent soiled surfaces.

3.5 PROTECTION

- A. Protect sealants until cured.

END OF SECTION 079200

SECTION 079233 - CONCRETE JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Exterior joints in the following horizontal traffic bearing surfaces:
 - a. Construction joints in cast-in-place concrete.
 - b. Control joints in slab-on-grade, pour strips, slabs, and topping slabs.
 - c. Joints between precast concrete units.
 - d. Perimeter of all floor drains.
- 2. Exterior joints in the following vertical and horizontal non-traffic surfaces:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between precast concrete units.
 - c. Cove joints at intersection of horizontal and vertical concrete.
 - d. Exterior horizontal joints between precast and cast-in-place concrete. Color to match precast concrete.
 - e. Vertical and horizontal joints between precast beams and columns at tiers exposed directly to weather color to match precast concrete.

- B. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:

- 1. Division 07 Section "Traffic Coatings"
- 2. Division 07 Section "Water Repellents"
- 3. Division 07 Section "Concrete Joint Sealants"
- 4. Division 07 Section "Expansion Joint Assemblies"

- C. Related Sections:

- 1. Division 03 Section "Cast-in-Place Concrete"
- 2. Division 03 Section "Precast Concrete"
- 3. Division 07 Section "Traffic Coatings"
- 4. Division 07 Section "Water Repellents"
- 5. Division 07 Section "Expansion Joint Assemblies"
- 6. Division 09 Section "Pavement Markings"

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
2. Distribute reviewed submittals to all others whose Work is related.
3. Coordinate layout of joint system and approve methods for providing joints with precast concrete and concrete contractors.
4. Inspect site and precast plant before precast production to insure proper joint configuration.

B. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.

C. Requests For Information

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated at least 60 days prior to application.

1. Product description, technical data, appropriate applications and limitations.
2. Primer type and application rate.

B. Samples:

1. One for each system indicated.

C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates:

1. Evidence of installer's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.
2. Certification from the Manufacturer that joint details as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive joint sealant.

B. Field Quality Control:

1. Two copies each of manufacturer's technical representative's log for each visit.
2. Testing agency field and test reports.

C. Qualification Statements:

1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Signed statement from this Section applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Three copies of systems maintenance manual.
- B. Five copies of snow removal guidelines for areas covered by warranty.
- C. Final executed Warranty.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted sealant, to include:
 - a. Name and location of project.
 - b. Type of sealant applied.
 - c. On-Site contact with phone number.

B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.

C. Installer's Qualifications: Owner retains right to reject any installer or subcontractor.

1. Installer shall be legally licensed to perform work in the state of North Carolina. Evidence of compliance with Summary article paragraph "A single installer. . ."
2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted sealant.
3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.

D. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.

E. Certifications:

1. Licensing/certification document from system manufacturer that confirms sealant installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of North Carolina.
2. Licensing/certification agreement shall include following information:
 - a. Applicator's financial responsibility for warranty burden under agreement terms.
 - b. Manufacturer's financial responsibility for warranty burden under agreement terms.
 - c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
 - d. Authorized signatures for both Applicator Company and Manufacturer.
 - e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to site in original, unopened containers, bearing following information:
 1. Name of product.
 2. Name of manufacturer.
 3. Date of preparation.
 4. Lot or batch number.
- B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

1.9 FIELD CONDITIONS

- A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

- A. Manufacturer: Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and installer with regard to warranty requirements (Joint and Several). The warranty shall provide that sealant will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:
 1. Any adhesive or cohesive failures.
 2. Weathering.
 3. Abrasion or tear failure resulting from normal traffic use.
- B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.
- C. Warranty period shall be a 5-year Joint and Several Warranty commencing with date of acceptance of work.
- D. Perform any repair under this warranty at no cost to Owner.

- E. Address the following in the terms of the Warranty: Length of warranty, change in value of warranty, if any, based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of following, only where specifically named in product category:
1. BASF Building Systems (BASF), Shakopee, MN.
 2. Dow Corning Corp. (Dow Corning), Midland, MI.
 3. Lyntal International Inc. (Lyntal), Lake Orion, MI.
 4. Pecora Corporation (Pecora), Harleysville, PA.
 5. Sika Corporation (Sika), North Canton, OH.
 6. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, JOINT SEALANT SYSTEM

- A. Provide complete system of compatible materials designed by manufacturer to produce waterproof, traffic-bearing control joints as detailed on Drawings.
- B. Compounds used for sealants shall not stain masonry or concrete. Aluminum pigmented compounds not acceptable.
- C. Color of sealants shall match adjacent surfaces.
- D. Closed cell or reticulated backer rods: Acceptable products:
1. "Sof Rod," Nomaco Inc., 501 NMC Drive, Zebulon, NC 27597. (800) 345-7279 ext. 341.
 2. "ITP Soft Type Backer Rod," Industrial Thermo Polymers Limited, 2316 Delaware Ave., Suite 216, Buffalo, NY 14216. (800) 387-3847.
 3. "MasterSeal 921 Backer Rod," BASF.
- E. Bond breakers and fillers: As recommended by system manufacturer.
- F. Primers: As recommended by sealant manufacturer.
- G. Acceptable sealants are listed below. Sealants shall be compatible with all other materials in this Section and related work.
- H. Acceptable polyurethane control joint sealants (traffic bearing):
1. MasterSeal SL-2 or MasterSeal SL-2 SG, BASF.
 2. Iso-flex 880 GB or Iso-flex 881, Lyntal.
 3. Dynatrol II-SG or Urexpan NR 200, Pecora.
 4. Sikaflex-2c SL or Sikaflex-2c NS TG, Sika.

5. THC-900, THC-901, Vulkem 45SSL, Dymeric 240, Dymeric 240 FC or Dymonic 100, Tremco.
- I. Acceptable silicone control joint sealants (traffic bearing):
 1. Spectrem 800 or Spectrem 900SL, Tremco.
 2. 310-SL or 311-NS, Pecora.
 3. Dow Corning SL, FC or NS Parking Structure Sealant, Dow Corning.
- J. Acceptable polyurethane vertical and cove joints sealants (non-traffic bearing):
 1. Sikaflex-2c NS, Sika.
 2. Dymeric 240/240FC, Dymonic 100 or THC 901 (cove only), Tremco.
 3. Dynatred, Pecora.
 4. Iso-flex 881, Lyntal.
- K. Acceptable silicone vertical and cove joint sealants (non-traffic bearing):
 1. Spectrem 1 or Spectrem 4-TS, Tremco.
 2. 311-NS, Pecora.
 3. Dow Corning NS Parking Structure Sealant, Dow Corning.
- L. Proposed Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.
- B. Coordinate and verify that related Work meets following requirements before beginning installation:
 1. Concrete surfaces are finished as acceptable for system to be installed.
 2. Curing compounds used on concrete surfaces are compatible with system to be installed.
 3. Concrete surfaces have completed proper curing period for system selected.

3.2 PREPARATION

- A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.
- B. Correct unsatisfactory conditions before installing sealant system.
- C. Acid etching is prohibited.

- D. Grind joint edges smooth and straight with beveled grinding wheel before sealing. All surfaces to receive sealant shall be dry and thoroughly cleaned of all loose particles, laitance, dirt, dust, oil, grease or other foreign matter. Obtain written approval of method from system manufacturer before beginning cleaning.
- E. Check preparation of substrate for adhesion of sealant.
- F. Prime and seal joints and protect as required until sealant is fully cured. A primer coat is required for all systems.

3.3 INSTALLATION/APPLICATION

- A. Do all Work in strict accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), thicknesses, and texture, and as shown on Drawings.
- B. Completely fill joint without sagging or smearing onto adjacent surfaces.
- C. Self-Leveling Sealants: Fill horizontal joints slightly recessed to avoid direct contact with wheel traffic.
- D. Fill joints flush (not concave) to receive traffic topping membrane.
- E. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.
- F. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40°F.

3.4 FIELD QUALITY CONTROL

- A. Contractor and Engineer/Architect will jointly determine which one of following 2 methods of sealant testing to verify sealant profile:
 - 1. Contractor, at Engineer/Architect's direction, shall cut out lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.
 - 2. Contractor, at Engineer/Architect's direction, shall install 3 trial joint sections of 20 ft each. Contractor shall cut out joint sections, as selected by Engineer/Architect, for Engineer/Architect and Manufacturer's Representative inspection. Additional isolated/random removals may be required where sealant appears deficient. Total cut out sealant shall not exceed lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.
- B. Repair all random joint sealant "cut out" sections at no cost to Owner.
- C. Testing Agency:

1. Check shore hardness per ASTM standard specified in sealant manufacturer's printed data.

END OF SECTION 079233

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SECTION 079500 - EXPANSION JOINT ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Standard expansion joint systems:
 - a. Elastomeric concrete edged, extruded rubber joint system.
 - 2. Vertical expansion joint systems:
 - a. Silicone faced expanding foam sealants.
- B. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:
 - 1. Division 07 Section "Traffic Coatings"
 - 2. Division 07 Section "Water Repellents"
 - 3. Division 07 Section "Concrete Joint Sealants"
 - 4. Division 07 Section "Expansion Joint Assemblies"
- C. Related Sections:
 - 1. Division 03 Section "Cast-in-Place Concrete"
 - 2. Division 03 Section "Precast Concrete"
 - 3. Division 04 Section "Unit Masonry", for masonry wall joint systems.
 - 4. Division 07 Section "Concrete Joint Sealants", for liquid-applied joint sealants.
 - 5. Division 09 Section "Pavement Markings"

1.3 DEFINITIONS

- A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width. Movement capability is to include anticipated movements from concrete shrinkage, concrete shortening and creep from post-tensioning or prestressing, cyclic thermal movements, and seismic movements.

- D. Nominal Joint Width: Width of linear opening specified in practice and in which joint system is installed.
- E. Nominal Form Width: Linear gap in joint system at time of forming or erection of structural elements bounding the expansion joint.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. General:

- a. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.
- b. Coordinate requirements for transitions, tolerances, levelness, and plumbness to ensure the installed expansion joint system can perform with expected movement capabilities.
- c. Coordinate and assign responsibility for preparation of concrete surfaces adjacent to expansion joints.
- d. Expansion joint surface areas each side of joint gap shall have a vertical differential less than 1/4" and meet requirements of expansion joint manufacturer.
- e. Minor surface defects shall be repaired according to manufacturer's recommendations. Repair materials shall be compatible with intended system materials and shall be approved by the Engineer prior to surface preparation and installation.
- f. Submit for approval repair products and procedures for all major defects. Repair description shall indicate materials, manufacturer's requirements, expected service life, and maintenance requirements. Take all precautions necessary to avoid damaging adjacent surfaces and embedded reinforcement or post tensioned anchors and tendons. Contractor is responsible for any damages. Concrete repairs shall be of rectangular configuration, with no feather-edged surfaces. Final surface preparation of all repairs shall be sandblasting, or approved equivalent.
- g. Coordinate layout of joint system and approval of methods for providing joints.

2. Joint Opening Width:

- a. Use temperature adjustment table to properly size joint gap at time of concrete pour and show that proposed joint system is capable of equal individual and combined movements in each direction when installed at designated temperature shown on drawings.
- b. Where installation temperature is other than specified temperature, perform calculations showing joint is capable of movement within design temperature range (Criteria on Drawings) for "other" temperature, and that design and installation follow manufacturer's recommendations.
- c. Expansion joint movement capability and the actual joint gap movement may not coincide. Construct actual joint gap in accordance with expansion design criteria.

3. Blockouts:

- a. Float expansion joint blockouts to remove all air pockets, voids, and spalls caused by form work.

- b. Blockouts shall be plumb with maximum tolerance per Manufacturer or not more than 0.125 inches deviation in 12 inches. Noncompliant blockouts shall be considered major defects.
 - c. Blockouts shall be straight and true with maximum tolerance per Manufacturer or not more than 0.250 inches deviation in 10 lineal feet. Noncompliant blockouts shall be considered major defects.
- B. Preinstallation Meetings: Meet at project site well in advance of time scheduled for Work to proceed to review requirements for Work and conditions that could interfere with successful expansion joint system performance. Require every party concerned with concrete formwork, blockout, concrete placement, or others required to coordinate or protect the Work thereafter, to attend. Include Engineer of Record and manufacturer's technical representative and warranty officer.
- C. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.
- D. Requests For Information: Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated:
 - 1. Construction details, material descriptions, dimensions, and finishes.
 - 2. Proposed method of preparation of concrete surface to receive expansion joint systems.
 - 3. Proposed method and details for treatment of cracks, bugholes, or other potential concrete surface defects in areas to receive expansion joint systems.
 - 4. Horizontal spacing between embedded metals and plates to allow for volume change due to thermal conditions.
 - 5. Temperature adjustment table showing formed gap at the time of concrete placement calculated at 10°F increments and a calculation showing joint system is capable of movement within the design temperature range.
- B. Shop Drawings: For each type of product indicated:
 - 1. Placement Drawings: Show project conditions including, but not limited to, line diagrams showing plans, elevations, sections, details, splices, blockout requirement, and terminations. Provide isometric or clearly detailed drawings depicting how components interconnect. Include reviewed and approved details from others whose work is related. Other information required to define joint placement or installation.

2. Components and systems required to be designed by a professional engineer, shall bear such professional's written approval when submitted.

C. Delegated Design Submittals:

1. Analysis indicating expansion joint system complies with expansion joint performance and design criteria of this specification and is suitable for use in conditions of this project. Provide a summary of design criteria used in design.

- D. Test and Evaluation Reports: Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for current products.

1.6 INFORMATIONAL SUBMITTALS

A. Certificates

1. Certification that products and installation comply with applicable federal, state of North Carolina, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
2. ADA Certification: Prior to installation, submit written certification from manufacturer indicating that expansion joints conform to Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1-800-872-2253.
 - a. Submit test reports from accredited laboratory attesting to joint systems' movement capability and ADA compliance.
 - b. Static coefficient of friction shall meet minimum requirements of Americans with Disabilities Act (ADA).
3. Signed statement from installer/applicator certifying that installer/applicator has read, understood, and shall comply with all requirements of this Section.
4. Signed statement from manufacturer's representative that they have read, understood, and shall comply with all requirements of this section.

B. Field Quality Control

1. Two copies each of manufacturer's technical representative's log for each visit.

C. Qualification Statements

1. Manufacturer's qualifications as defined in the "Quality Assurance" article within 60 days of project award.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Evidence of manufacturer's certification of installer/applicator. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Contracts: 2 copies of Maintenance Program contracts.

B. Operation and Maintenance Data

1. Maintenance Manual: 3 copies of System Maintenance Manual.

C. Warranty Documentation: 2 executed copies of Labor and Material Warranty including all terms, conditions, and maintenance requirements.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Copy of sample warranty that meets the requirements of the "Warranty" article in Section 1.
3. Evidence of financial stability acceptable to Owner or Engineer/Architect.
4. Evidence of compliance with "Single Installer" requirement.

B. Installer Qualifications: An employer of workers, including superintendent for this project, trained and approved by manufacturer.

C. Testing Agency: Independent testing laboratory employed by owner and acceptable to Engineer/Architect.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

1.10 WARRANTY

A. Warranty period shall be a 5-year labor and materials warranty commencing with date of acceptance of work.

B. Installation Requirements: Include a written plan of construction and coordination requirements, to allow joint system installation to proceed with specified warranty, that specifically addresses the following:

1. Block out acceptance criteria.
2. Surface preparation acceptance criteria.
3. Crack, surface defect, and detailing recommendations.
4. Method of protection of surrounding surfaces.
5. Method of expansion joint system installation description.

6. Primer type and application rate.
 7. Method of preparation of all glands and reinforced membranes.
 8. Temperature, humidity, and other weather constraints. Specify substrate moisture testing criteria, if any.
 9. Final cure time before removal of protection, resumption of traffic, and/or paint striping.
 10. Any other special instructions required to ensure proper installation.
- C. Quality Service Requirements: Show evidence of licensed/approved installer. List of names, addresses and phone numbers, with copies of certification/approval agreement with each, satisfies requirement. Licensing/certification agreement shall include following information:
1. Installer's financial responsibility for warranty burden under agreement terms.
 2. Manufacturer's financial responsibility for warranty burden under agreement terms.
 3. Process for dispute settlement between manufacturer and installer in case of system failures where cause is not evident or cannot be assigned.
 4. Authorized signatures for both Installer Company and Manufacturer.
 5. Commencement date of agreement and expiration date (if applicable).
 6. Provide copy of contractor's field application quality control procedures.
- D. Warranty shall be jointly executed by Manufacturer and Installer for labor and materials. Detail responsibilities of General Contractor, manufacturer and installer with regard to warranty requirements, as outlined in the Manufacturer's warranty and related Licensing/Certification documents. Warranty shall provide that system shall be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:
1. Any water leakage through expansion joint system or leaking conditions of reinforced membrane, other waterproofing components, or glands.
 2. Any adhesive or cohesive failures of the system.
 3. Tears, weathering, or degradation in gland from normal use.
 4. Expansion joint glands are considered defective if they buckle upwards beyond the level of the floor surface after installation or downward in excess of 1/2 inch below the floor surface.
- E. If expansion joint systems or components show any of defects listed above, supply labor and material to repair all defects at no cost to Owner.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. A single Installer shall be responsible for providing complete expansion joint system. Obtain all joint systems through one source from a single manufacturer.
- B. Drawings indicate size, profiles, and dimensional requirements of joint systems and are schematic for systems indicated.
- C. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

- A. Intent of this section is to insure that installed expansion joints allow pedestrian and vehicular traffic to pass in a smooth, quiet fashion with minimal maintenance required over a period of not less than 10 years. Expansion joints shall not only function as structural bridging elements, but must also accommodate structural expansions/contractions and minimize water leakage.
- B. Expansion joint design shall meet or exceed all expected movements shown on drawings.
- C. Installation temperature range and estimated volume change movements are shown on drawings. Nominal form width shown on the drawings shall be adjusted for the ambient temperature at time of concrete placement and designer shall verify that width of joint at installation shall meet minimum installation requirements.
- D. Expansion joint systems shall be capable of resisting a differential vertical movement of 1/2 inch.
- E. Materials shall be supplied in lengths to minimize or eliminate the need to splice waterproofing components.
 - 1. Waterproofing materials directly exposed to vehicular traffic shall be supplied with no joints in vehicle drive aisles.
 - 2. All mitered splices shall be performed at the factory and provide sufficient gland length for butt splicing with field splicing equipment.
 - 3. All Santoprene butt to butt splices shall be heat welded.
 - 4. Butt to butt splices with other materials shall be per manufacturer's recommendations.
- F. Design system for passenger vehicles traveling at speeds normally expected within a parking structure.
- G. Walking Surfaces: Expansion joint assemblies at walking areas subject to pedestrian traffic shall provide a smooth, slip resistant walking surface for pedestrians with these minimum requirements:
 - 1. Shall provide walking surfaces in accordance with ASTM – F 1637 Standard Practice for Safe Walking Surfaces.
 - 2. Shall be designed to comply with “Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)” Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1-800-872-2253.
 - 3. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:
 - a. Changes in level of less than 1/4 inch in height may be without edge treatment as shown in ADA Figure 303.2 and on the Drawings.
 - b. Changes in Level between 1/4 inch and 1/2 inch in height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3 and on the Drawings.
 - c. Changes in level greater than 1/2 inch in height are not permitted unless they can be transitioned by means of a ramp as shown on Drawings.
 - d. Openings in floor or ground surfaces shall not allow passage of a sphere more than 1/2 inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3 and on the Drawings.

2.3 MANUFACTURERS

- A. Subject to compliance with requirements, provide products from one of following manufacturers (listed in alphabetical order), only where specifically named in product categories:

1. Balco, Inc., Wichita, KS (Balco).
2. Construction Specialties, Inc., Muncy, PA (C/S).
3. Dow Corning Corp., Midland, MI (Dow Corning).
4. Emseal Joint Systems, Westborough, MA (Emseal).
5. Erie Metal Specialties, Inc., Akron, NY (EMS).
6. Lymtal International Inc. Lake Orion, MI (LymTal).
7. MM Systems Corporation, Atlanta, GA (MM).
8. TechStar, Inc., Findlay, OH (TechStar).
9. Tremco, Cleveland, OH (Tremco).
10. Watson Bowman Acme Corporation, a Division of BASF Construction Chemicals NA, Amherst, NY (WBA).

2.4 PRODUCTS, STANDARD EXPANSION JOINT SYSTEMS

- A. Extruded EPDM rubber expansion joint system with integral nosing:

1. Epoxy-Bonded EPDM Seal, Model ZB, C/S.

- B. Elastomeric concrete edged, extruded rubber expansion joint system:

1. DuraFlex Chambered Wing Seal CS and DCS Series, Balco.
2. Iso-Flex Winged Joint System J Series, LymTal.
3. Lokcrete Membrane System (LMS) Series, MM.
4. Polycrete/Membrane System, Type CR Series, EMS.
5. Thermaflex Membrane/Nosing System, Type TM and TCR Series, Emseal.
6. Vulkem WF series Vehicular Expansion Joint System, Tremco.
7. Wabo®Crete Membrane System ME Series, WBA.

- C. Adhered extruded rubber expansion joint sealant system:

1. C/S Hybrid Compression Seal, Model HB, C/S.
2. Cebreg System, J or JP Series, EMS.
3. DuraFlex™ Elastic Seal ES Series, Balco.
4. Epoxy Bonded Sealing System, EBS Series, MM.
5. Iso-Flex Pressure Lok, Q Series, LymTal.
6. Jeene® Structural Sealing Joint System, WBA.

- D. Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

2.5 PRODUCTS, OTHER

- A. Silicone Faced Expanding foam sealants. Architect to choose color from manufacturers standard color chart.

1. ColorJoint Silicone Sealing System, ESS Series, MM.
2. Seismic Colorseal, Emseal.

3. Iso-Flex Precom "C", LymTal.
4. Wabo Seismic WeatherSeal, WBA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and blockouts where expansion joint systems will be installed for installation tolerances and other conditions affecting performance of Work.
- B. Check elevations on each side of expansion joint gap to ensure flush slab-to-slab transition.
- C. Check anticipated or actual minimum and maximum joint openings. Compare to manufacturer's movement specifications and make joint sizing recommendations.
- D. Coordinate and verify that related Work meets following requirements:
 1. Check adhesion to substrates and recommend appropriate preparatory measures.
 2. Curing compounds used on concrete surfaces are compatible with Work to be installed.
 3. Concrete surfaces have completed proper curing period for system selected.
 4. Coordinate expansion joint system with other related Work before installation of expansion joint.
 5. Verify expansion joints are compatible with Joint Sealants and traffic toppings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.
- F. Cease installation if expansion joint blockouts and/or openings exhibit cracked edges, voids, or spalls. Repair with approved material prior to installation of expansion joint.
- G. Correct unsatisfactory conditions in manner acceptable to Manufacturer and Engineer before installing joint system.

3.2 PREPARATION

- A. Prepare for installation of expansion joint systems in accordance with manufacturer's recommendations
- B. Surface Preparation:
 1. Acid etching: Prohibited.
 2. Prepare substrates according to joint system manufacturer's written instructions.
 3. Clean joints thoroughly in accordance with manufacturer's instructions to remove all laitance, unsound concrete, and curing compounds which may interfere with adhesion.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing joint assemblies and materials unless more stringent requirements are indicated.

- B. Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.
- C. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturers recommended limitations for installation, or when temperature of work area or substrate are below 40°F.
- D. Terminate exposed ends of joint assemblies with field- or factory-fabricated termination devices.
- E. Seal all openings to occupied spaces to prevent cleaning materials, solvents, and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.
- F. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Field Tests and Inspections: Prior to opening to traffic, test joint seal for leaks by maintaining continuously wet for 12 hours. Repair leaks revealed by examination of seal underside. Repeat test and repairs until all leaks stopped for full 12 hours.
- B. Manufacturer Services: Provide qualified manufacturer's technical representative for periodic inspection of Work at critical time of the installation, including but not limited to pre-concrete formwork and placement site meetings, block out inspection, surface defect repair, surface preparation, metal work, expansion gland installation, and waterproofing system installation.

3.5 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of Work.

END OF SECTION 079500

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections located in the Bid Package Manual, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Standard hollow-metal steel doors.
 - 2. Standard hollow-metal steel frames.
- B. Related Sections include the following:
 - 1. Section 042000 - "Unit Masonry" for building anchors into and grouting standard steel frames in masonry construction.
 - 2. Section 087100 - "Door Hardware" for door hardware for standard steel doors and frames.
 - 3. Sections 099113 - "Exterior Painting" for field painting standard steel doors and frames.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, and finishes for each type of steel frame specified.
- B. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:
 - 1. Elevations of each door design.
 - 2. Frame details for each frame type, including dimensioned profiles.
 - 3. Details and locations of reinforcement and preparations for hardware.
 - 4. Details of anchorages, accessories, joints, and connections.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

- B. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4 inch (102 mm) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating standard steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.7 COORDINATION

- A. Coordinate installation of anchorages for standard steel frames. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ceco Door Products; an ASSA ABLOY Group Company.
 - 2. CURRIES Company; an ASSA ABLOY Group Company.
 - 3. Fleming Door Products Ltd.; an ASSA ABLOY Group Company.
 - 4. Republic Builders Products Company.
 - 5. Steelcraft; an Ingersoll-Rand Company.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) zinc-iron-alloy (galvannealed) coating designation.
- D. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.
- F. Grout: Comply with Section 042000 "Unit Masonry."

2.3 STANDARD STEEL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.
 - 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
 - a. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W) when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
 - 4. Top and Bottom Edges: Closed with flush or inverted 0.042 inch (1.0 mm) thick end closures or channels of same material as face sheets.
 - 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
- C. Hardware Reinforcement: Fabricate reinforcement plates from same material as door face sheets to comply with the following minimum sizes:
 - 1. Hinges: Minimum 8 gauge by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
 - 2. Lock Face Closers, and Concealed Holders: Minimum 14 gauge.
 - 3. All Other Surface-Mounted Hardware: Minimum 14 gauge.
- D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
 - 1. Fabricate frames with mitered or coped and knockdown face corners and seamless face joints.
 - 2. Frames for Level 2 Steel Doors: 14 gauge steel sheet, unless otherwise indicated.

- C. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:
 - 1. Hinges: Minimum 0.123 inch (3.0 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (152 mm) longer than hinge, secured by not less than 6 spot welds.
 - 2. Lock Face Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.
 - 3. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.
- D. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.
- E. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm)
- F. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- G. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.5 ACCESSORY MATERIALS

- A. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling.
- B. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- C. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.6 STOPS AND MOLDINGS

- A. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch (16 mm) high, unless otherwise indicated.

2.7 FABRICATION

- A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
3. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
4. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 2) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.8 STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish standard steel frames after assembly.
- B. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.018 mm).
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of standard steel doors and frames.
 - 1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.

3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap frames to receive non-templated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Install door silencers in frames before grouting.
 - b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - c. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - d. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. At Bottom of Door: [3/4 inch (19.1 mm)] [5/8 inch (15.8 mm)] plus or minus 1/32 inch (0.8 mm).
 - c. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel frames that are warped, bowed, or otherwise unacceptable.
- B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.
- C. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazed aluminum curtain walls.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.

- E. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in North Carolina.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- C. Product Test Reports: For glazed aluminum curtain walls, for tests performed by a qualified testing agency.
- D. Field quality-control reports.
- E. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- D. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of curtain wall assemblies.

1.7 MOCKUPS

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as directed by the Architect
 - 2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

- A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: Five years from date of Final Acceptance.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 10 years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.

- B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to $1/175$ of clear span for spans up to 13 feet 6 inches (4.1 m) and to $1/240$ of clear span plus $1/4$ inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to $3/4$ inch (19.1 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to $1/360$ of clear span or $1/8$ inch (3.2 mm), whichever is smaller.
- E. Structural: Test according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
 - 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
- G. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
 - 1. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

- H. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- J. Structural-Sealant Joints:
 - 1. Designed to carry gravity loads of glazing.
 - 2. Designed to produce tensile or shear stress of less than 20 psi (138 kPa).
- K. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
 - 1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO 5600 2-1/2 Inch System or comparable product by one of the following:
 - 1. Kawneer North America.
 - 2. Tubelite.
 - 3. Oldcastle Building Envelope.
 - 4. United States Aluminum.
 - 5. YKK AP America Inc.
- B. Source Limitations: Obtain all components of curtain wall system, including framing and accessories, from single manufacturer.

2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Nonthermal.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.

3. Glazing Plane: Front.
 4. Finish: As scheduled.
 5. Fabrication Method: Either factory- or field-fabricated system.
- B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
1. Include snap-on aluminum trim that conceals fasteners.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.
1. Color: As selected by Architect from manufacturer's full range of colors.
- C. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.
1. Color: Match structural sealant.

2.5 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Silicone Transition Systems: Preformed silicone elastomer extrusion as required and in accordance with curtain wall manufacturer's standards.
 - 1. Acceptable Manufacturers:
 - a. Dow Corning Silicone Transition System.
 - b. Tremco Proglaze.
 - c. Pecora
- D. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- E. Aluminum Sills: Extruded aluminum matching curtain wall framing in high performance finish matching curtain wall finish.
- F. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.

6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Fabricate components to resist water penetration as follows:
 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.
- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISH

- A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory after products are assembled. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces which will be visible after completing finishing process.
 1. Provide Color as indicated or, if not otherwise indicated, as selected by architect from standard Kynar 500 colors.
- B. Fluorocarbon Coating: Inhibitive thermo-cured primer, 0.2 mil minimum dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500" resin, 1.0 mil minimum dry film thickness.
 1. Furnish manufacturer's twenty (20) year guarantee of "Kynar 500" finish.
 2. Finish shall be applied in the plant of the manufacturer.

2.8 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 088000 "Glazing."

1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

F. Install weatherseal sealant according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).

2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
 1. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
- C. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
 1. Test a minimum of six areas on each building facade.
 2. Repair installation areas damaged by testing.
- D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 084413

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Glazing units.

1.2 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealants for other than glazing purposes.
- B. Section 084413 - Glazed Aluminum Curtain Walls: Glazing furnished as part of curtain wall assembly.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- C. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- D. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.
- E. GANA (GM) - GANA Glazing Manual.
- F. GANA (SM) - GANA Sealant Manual.
- G. GANA (LGRM) - Laminated Glazing Reference Manual.
- H. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use.

1.4 SUBMITTALS

- A. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- B. Samples: Submit two samples 12 by 12 inch (305 by 305 mm) in size of glass units.
- C. Samples: Submit 6 inch (152 mm) long bead of glazing sealant, color as selected.
- D. Certificates: Certify that products meet or exceed performance specified.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods.

1.6 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. AGC Glass Company North America, Inc.
 - 2. Cardinal Glass Industries.
 - 3. Guardian Industries Corp.
 - 4. Pilkington North America Inc.
 - 5. Vitro Architectural Glass.

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
 - 1. Design Pressure: Calculated in accordance with ASCE 7.
 - 2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 - 3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 - 4. Glass thicknesses listed are minimum.

2.3 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
 - 1. Kind FT - Fully Tempered Type: Complies with ASTM C1048.

2.4 GLAZING UNITS

A. Monolithic Vision Glazing:

1. Applications: Exterior glazing unless otherwise indicated.
2. Glass Type: Fully tempered float glass.
3. Tint: Clear.
4. Thickness: 1/2 inch (12.8 mm), nominal.

B. Spandrel glazing.

1. Applications: Exterior spandrel glazing unless otherwise indicated.
2. Spandrel Glass: Fully tempered float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Same as on vision units, on #2 surface.
3. Total Thickness: 1/2 inch (12.8 mm).

PART 3 - EXECUTION

3.1 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.2 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, stucco, mortar droppings, etc.

3.4 INSTALLATION - STRUCTURAL SILICONE GLAZING

- A. Refer to Section 084413 for wall framing assembly requirements.
- B. Application - Field Glazed: Follow basic guidelines of structural silicone glazing for glazing application.
 - 1. Four-Sided Structural: Glass with four sides structurally adhered to horizontal and vertical metal back-up mullion.
- C. Provide design review of the glazing system and project details, adhesion testing, proper surface preparation, training and a quality service program.
- D. Provide only structural silicone sealant, tested and manufactured for structural glazing.

3.5 FIELD QUALITY CONTROL

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

3.6 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

END OF SECTION 088000

SECTION 089513 - SOFFIT VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes soffit vents.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of metal finish required.

PART 2 - PRODUCTS

2.1 SOFFIT VENTS

- A. Extruded-Aluminum Soffit Vents:
 - 1. Extruded-aluminum soffit vents, not less than 0.125-inch (3.18-mm) nominal thickness, assembled by welding; with ½ inch square mesh, 0.063 inch wire bird screen and 18-by-14- (1.4-by-1.8-mm-) mesh, aluminum insect screening on inside face.
 - 2. Size: As indicated on the Drawings.

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

2.3 FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locate and place vents level, plumb, and at indicated alignment with adjacent work.
- B. Install vents into adjacent work as construction progresses
- C. Use concealed anchorages.

3.2 ADJUSTING AND CLEANING

- A. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- B. Restore vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 089513

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior wall assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 645; roll-formed from hot-dipped galvanized steel; complying with ASTM A 1003/A 1003M and ASTM A 653/A 653M G40 (Z120) or having a coating that provides equivalent corrosion resistance. A40 galvanized products are not acceptable.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645. Use either steel studs and runners or equivalent gauge steel studs and runners.
1. Equivalent Gauge Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.019 inch (20 gauge).
 - b. Depth: As indicated on Drawings.

2.2 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install bracing at terminations in assemblies.

3.3 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
- B. Install studs so flanges within framing system point in same direction.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
- D. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092400 - STUCCO

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior vertical stucco.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples: For each type of factory-prepared finish coat and for each color and texture specified.
- D. Samples for Verification: For each type of factory-prepared finish coat and for each color and texture specified, 12 by 12 inches (305 by 305 mm), and prepared on rigid backing.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups for each substrate and finish texture indicated for cement stuccoing, including accessories.
 - a. Size: 100 sq. ft. (9 sq. m) in surface area.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 FIELD CONDITIONS

- A. Comply with ASTM C 926 requirements.
- B. Exterior Stuccowork:
 - 1. Apply and cure stucco to prevent stucco drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
 - 2. Apply stucco when ambient temperature is greater than 40 deg F (4.4 deg C).
 - 3. Protect stucco coats from freezing for not less than 48 hours after set of stucco coat has occurred.

PART 2 - PRODUCTS

2.1 METAL LATH

- A. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized-zinc coating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alabama Metal Industries Company; a Gibraltar Industries company.
 - b. ClarkDietrich.
 - c. MarinoWARE.
 - 2. Diamond-Mesh Lath: Self-furring, 2.5 lb/sq. yd. (1.4 kg/sq. m).
- B. Paper Backing: FS UU-B-790a, Type I, Grade D, Style 2 vapor-permeable paper.
 - 1. Provide paper-backed lath unless otherwise indicated at exterior locations.

2.2 ACCESSORIES

- A. General: Comply with ASTM C 1063, and coordinate depth of trim and accessories with thicknesses and number of stucco coats required.
- B. Metal Accessories:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alabama Metal Industries Company; a Gibraltar Industries company.
 - b. ClarkDietrich .
 - c. MarinoWARE.
 - 2. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized-zinc coating.
 - 3. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.

4. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
5. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on stucco face of control joint.

2.3 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Stucco: Potable and free of substances capable of affecting stucco set or of damaging stucco, lath, or accessories.
- B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in cement stucco.
- C. Fasteners for Attaching Metal Lath to Substrates: ASTM C 1063.
- D. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter unless otherwise indicated.

2.4 STUCCO MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I.
 1. Color for Finish Coats: White.
- B. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
- C. Sand Aggregate: ASTM C 897.
 1. Color for Job-Mixed Finish Coats: White.
- D. Ready-Mixed Finish-Coat Stucco: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Florida Stucco.
 - b. LaHabra Stucco Solutions; Parex USA.
 - c. Omega Products International, Inc.
 - d. SonoWall, BASF Corp.
 2. Color: As selected by Architect from manufacturer's full range.

2.5 STUCCO MIXES

- A. General: Comply with ASTM C 926 for applications indicated.
 1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.

- B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat stuccowork as follows:
 - 1. Portland Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- C. Job-Mixed Finish-Coat Mixes:
 - 1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
- D. Factory-Prepared Finish-Coat Mixes: For ready-mixed finish-coat stuccos, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by stuccoing.
- B. Prepare smooth, solid substrates for stucco according to ASTM C 926.

3.3 INSTALLING METAL LATH

- A. Metal Lath: Install according to ASTM C 1063.
 - 1. Partition Framing and Vertical Furring: Install flat-diamond-mesh lath.
 - 2. Flat-Ceiling and Horizontal Framing: Install flat-diamond-mesh lath.

3.4 INSTALLING ACCESSORIES

- A. Install according to ASTM C 1063 and at locations indicated on Drawings.
- B. Control Joints: Locate as approved by Architect for visual effect and as follows:
 - 1. As required to delineate stuccowork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 sq. ft. (13.4 sq. m).
 - 2. At distances between control joints of not greater than 18 feet (5.5 m) o.c.

3. As required to delineate stuccowork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4. Where control joints occur in surface of construction directly behind stucco.

3.5 STUCCO APPLICATION

A. General: Comply with ASTM C 926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet (6 mm in 3 m) from a true plane in finished stucco surfaces when measured by a 10-foot (3-m) straightedge placed on surface.
2. Finish stucco flush with metal frames and other built-in metal items or accessories that act as a stucco ground unless otherwise indicated. Where casing bead does not terminate stucco at metal frame, cut base coat free from metal frame before stucco sets and groove finish coat at junctures with metal.

B. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat stuccowork with 3/4-inch (19-mm) total thickness, as follows:

1. Portland cement mixes.

C. Stucco Finish Coats: Apply to provide finish to match Architect's sample.

3.6 STUCCO REPAIRS

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of other work after stucco is complete. Promptly remove stucco from door frames, windows, and other surfaces not indicated to receive stucco. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during stuccoing.

END OF SECTION 092400

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Unbacked rubber sheet flooring.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of resilient sheet flooring, in manufacturer's standard size, but not less than 6-by-9-inch (150-by-230-mm) sections of each color, texture, and pattern required.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Resilient Sheet Flooring: Furnish not less than 10 linear feet (3 linear m) in roll form and in full roll width for color, and pattern of flooring installed.

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store rolls upright.

1.8 FIELD CONDITIONS

- A. Close spaces to traffic during resilient sheet flooring installation.
- B. Close spaces to traffic for 48 hours after resilient sheet flooring installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 UNBACKED RUBBER SHEET FLOORING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexco.
 - 2. Johnsonite; a Tarkett company.
 - 3. Nora Systems, Inc.
 - 4. R.C.A. Rubber Company (The).
- B. Product Standard: ASTM F1859.
 - 1. Type: Type I, homogeneous rubber sheet floor covering.
 - 2. Thickness: As standard with manufacturer.
 - 3. Hardness: Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D2240.
- C. Wearing Surface: Molded pattern.
 - 1. Molded-Pattern Figure: Raised discs.
- D. Sheet Width: 6.3 feet (1.9 m).
- E. Seamless-Installation Method: Chemically bonded.
- F. Colors and Patterns: As selected by Architect from manufacturer's full line.

2.3 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.
- B. Seamless-Installation Accessories:
 - 1. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient sheet flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 RESILIENT SHEET FLOORING INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.
- C. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- D. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- F. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- G. Seamless Installation:
 - 1. Chemically Bonded Seams: Bond seams with chemical-bonding compound to fuse sections permanently into a seamless flooring installation. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.
- B. Perform the following operations immediately after completing resilient sheet flooring installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.

- C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.
 - 1. Apply one coat.
- E. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 096516

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints and stains.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Exposed surfaces of steel lintels and ledge angles.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

- A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.
- B. SSPC-SP 1 - Solvent Cleaning.
- C. SSPC-SP 6 - Commercial Blast Cleaning.

1.3 SUBMITTALS

- A. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).

3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- B. Samples: Submit two paper chip samples, 6 by 6 inch (152 by 152 mm) in size illustrating range of colors and textures available for each surface finishing product scheduled.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. Extra Paint and Finish Materials: 5 gallons (20 L) of each color; from the same product run, store where directed.
 2. Label each container with color in addition to the manufacturer's label.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.5 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.

B. Paints:

1. Base Manufacturer: Sherwin-Williams Company: www.sherwin-williams.com.
2. Other Acceptable Manufacturers:
 - a. Pratt & Lambert Paints: www.prattandlambert.com.
 - b. PPG Paints: www.ppgpaints.com/#sle.

C. Exterior Concrete and CMU Paint/Stain, factory formulated. Apply 2 coats, each coat shall meet manufacturer's minimum mil thickness and/or application rate for bare concrete substrates. Color shall be white. Provide one of the following:

1. BASF: White Roc Toner VOC
2. United Coatings: Canyon Tone Stain
3. Porter Coatings: Color Seal Acrylic Waterproofing Sealer No. PP3249
4. PPG: Perma-Crete Color Seal WB Acrylic Concrete Stain
5. Sherwin Williams: H & C Concrete Stain

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

C. Colors: To be selected from manufacturer's full range of available colors.

1. Selection to be made by Architect after award of contract.

2.3 PAINT SYSTEMS - EXTERIOR

A. Stucco:

1. Prime Coat: Primer sealer, latex.
 - a. S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
2. Topcoat: Latex, exterior, low sheen.
 - a. S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

B. Concrete and CMU Paint/Stain:

1. Double Tees: Bottom of flanges and sides and bottom of stems. Occurs on all floor levels.
2. Beams: Bottom and both sides. Occurs on all floor levels.
3. Columns: All four sides from floor to bottom of double tee flanges above, including corbels. Occurs on all floor levels.
4. Light Walls: Both sides, ends, and faces of openings from floor to bottom of double tee flanges above, including corbels. Occurs on all floor levels.
5. Shear Walls: Both sides, ends, and faces of openings from floor to bottom of double tee flanges above. Occurs on all floor levels.
6. Other Walls: Faces and edges of walls facing main parking area. Occurs on all floor levels.
7. Spandrels: At perimeter spandrels, vertical interior face from bottom of spandrel to bottom of double tee flanges above, including corbels. Occurs on all floor levels.
8. Stair Towers: Ceilings and walls. Occurs on all levels.

C. Ferrous Metals, Unprimed, Latex, 3 Coat:

1. One coat of latex primer: S-W DTM Acrylic Primer/Finish, B66W1
2. Semi-gloss: Two coats of latex enamel; S-W DTM Acrylic Semi-Gloss Coating, B66-200 Series

D. Ferrous Metals, Primed, Latex, 2 Coat:

1. Touch-up with latex primer: S-W DTM Acrylic Primer/Finish, B66W1
2. Semi-gloss: Two coats of latex enamel; S-W DTM Acrylic Semi-Gloss Coating, B66-200 Series

2.4 ACCESSORY MATERIALS

- ### A. Accessory Materials:
- Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Exterior Stucco: 12 percent.
 - 2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete:
 - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 2. Prepare surface as recommended by top coat manufacturer.

G. Masonry:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
2. Prepare surface as recommended by top coat manufacturer.

H. Stucco: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

I. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance.
- D. Sand metal surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 099113

SECTION 09 91 20 - PAVEMENT MARKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pavement Marking - Surface preparation and application of paint systems for the high build, two coat systems for the items of types, patterns, sizes, and colors described in this article.
- B. Provide the following systems as shown on Drawings:
 - 1. Parking Stall Stripes.
 - 2. Traffic Arrows, crosswalks, accessible stall access aisles, walkways, symbols, stop bars, words, and other markings.
 - 3. International Symbol of Accessibility.
- C. Provide painting of curbs and curb ramps as described in the following paragraphs:
 - 1. Paint vertical surface and the first 6 in. of the abutting horizontal surface at the top of all curbs and islands (including PARCS equipment islands) within parking facility except those which do not exceed 3'0" in width and abut a wall, spandrel panel, bumper wall guardrail or other construction (not including landscaping or equipment) which prevents passage of pedestrians.
 - 2. In parking areas and/or at streets and sidewalks within the project limits or constructed as part of this project, paint curb ramps (including flares), curb returns at curb ramps and any projecting elements at edges of accessible ramps without handrails. Paint curb returns at driveways and paint curb minimum of 3 ft either side of curb ramp or driveway, (or curb ramp flare length, whichever is greater) in accordance with Pavement Marking.
 - 3. Paint color for curbs and curb ramps shall be yellow.
- D. Proportion International Symbol of Accessibility in accordance with ICC A117.1-2009 Accessible and Usable Buildings or 2010 ADA Standards for Accessible Design.
- E. Related Work:
 - 1. Pavement Marking Contractor shall verify compatibility with sealers, joint sealants, caulking, and all other surface treatments as specified in Division 07.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Provide product data as follows:
 - 1. Manufacturer's certification that the material complies with standards referenced within this Section.
 - 2. Intended paint use.
 - 3. Pigment type and content.
 - 4. Vehicle type and content.
- C. Submit list of similar projects (minimum of 5) where pavement-marking paint has been in use for a period of not less than 2 yrs.
- D. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including cost of Engineer's services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.
- E. Requests For Information: Engineer reserves right to reject, unprocessed, any Request for Information (RFI) that Engineer, at its sole discretion, deems frivolous and/or deems already answered in the Contract Documents. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in Contract documents.

1.4 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 degrees F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

1.5 QUALITY ASSURANCE

- A. Provide written 1-year warranty to Owner that pavement markings will be free of defects due to workmanship, inadequate surface preparation, and materials including, but not limited to, fading and/or loss of markings due to abrasion, peeling, bubbling and/or delamination. Excessive delamination, peeling, bubbling or abrasion loss shall be defined as more than 15% loss of marking material within one year of substantial completion and/or occupancy of the parking area. With no additional cost to Owner, repair and/or recoat all pavement marking where defects develop or appear during warranty period and all damage to other Work due to such defects.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pavement marking materials shall meet Federal, State and Local environmental standards.

- B. Paint shall be manufactured and formulated from first grade raw materials and shall be free from defects or imperfections that might adversely affect product serviceability.
- C. Paints shall comply with the National Organic Compound Emission Standards for Architectural Coatings, Environmental Protection Agency, 40 CFR Part 59.
- D. The product shall not contain mercury, lead, hexavalent chromium, or halogenated solvents.

2.2 PAVEMENT MARKING PAINTS ON SURFACES IN GARAGE

- A. Epoxy paint may be used for all markings, unless noted otherwise on the Drawings. Paint shall be a two-component system consisting of minimum 99 percent solids. The material shall be specifically formulated as a pavement marking material and shall be spray applied at ambient temperatures.
 - 1. The specific paint formulation shall be approved for use on highways by the state and/or local DOT where the project is located.
- B. Solvent based paint may be employed for white and yellow pavement markings and shall meet the requirements of MPI #32.
- C. 100% acrylic waterborne paint shall be used for white and yellow pavement markings and shall meet requirements of MPI #70.
 - 1. All products shall have performance requirements of Type I and II of Federal Standard TT-P-1952E.

2.3 PAVEMENT MARKING PAINTS ON PARKING LOT SURFACES

- A. Pavement Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready-mixed complying with FS TT-P-1152, Type II, with drying time of less than 45 minutes.
 - 1. Color: As Indicated.

2.4 COLOR OF PAINT

- A. Paint color of white, where shown on Contract Drawings, shall match federal color chip No. 37925 and daylight directional reflectance (without glass beads) shall not be less than 84% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.
 - 1. Parking space striping
- B. Paint color of yellow, where shown on Contract Drawings, shall match federal color chip No. 33538, commonly referred to as federal highway yellow. Color shall have daylight directional reflectance (without glass beads) of not less than 50% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.
 - 1. Non -parking diagonal cross-hatch areas

2. Centerlines
3. Drive aisle lane alongside shear walls
4. Curbs

- C. Paint color for blue accessible parking space pavement markings, where shown on Contract Drawings, shall match federal color chip No. 35180. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

1. ADA parking spaces and access aisles

- D. Paint color for red, special-use parking space pavement markings, where shown on Contract Drawings, shall match federal color chip No. 31136. The Light Reflectance Value (without glass beads) shall not be less than 10%.

1. Standpipe access aisles

2.5 BEADS

- A. Use Glass Beads (Spheres) in all pavement markings except stall striping lines. Conform to Federal Specification TT-B-1325D, Type I. Broadcast beads into markings at rate not less than 6 lbs. per gallon of paint.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.
- D. Striping shall not be placed until full cure of concrete slab and sealer. Concrete surfaces generally require 30 to 90 days @ 70°F or higher. Sealers (other than silane) generally require 14 days @ 70°F or higher. Silane sealers require 24 hrs @ 70°F or higher. Bituminous surfaces generally require 30 days @ 45° F or higher.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

- B. Do not paint or finish any surface that is wet or damp.
- C. Clean substrates of substances that could impair bond of paints, including dirt, dust, oil, grease, and incompatible paints and encapsulants.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Lay out all striping on each tier, using dimensions and details shown on Contract Drawings, before painting that tier. Report any discrepancies, interferences, or changes in striping due to field conditions to Engineer/Architect prior to painting. Pavement Marking Contractor shall be required to remove paint, repair surface treatment, and repaint stripes not applied in strict accordance with Contract Drawings.
- F. Work Areas:
 - 1. Store, mix and prepare paints only in areas designated by Contractor for that purpose.
 - 2. Provide clean cans and buckets required for mixing paints and for receiving rags and other waste materials associated with painting. Clean buckets regularly. At close of each day's Work, remove used rags and other waste materials associated with painting.
 - 3. Take precautions to prevent fire in or around painting materials. Provide and maintain appropriate hand fire extinguisher near paint storage and mixing area.
- G. Mixing:
 - 1. Do not intermix materials of different character or different manufacturer.
 - 2. Do not thin material except as recommended by manufacturer.
- H. Disposal:
 - 1. Contractor shall properly dispose of unused materials and containers in compliance with Federal Resource Conservation Recovery Act (RCRA) of 1976 as amended, and all other applicable laws and regulations.

3.3 APPLICATION

- A. Apply paint in 2-coat system; first coat shall be 50% of total 15 wet mil minimum thickness, not to exceed 8 mils. First coat shall be cured prior to installation of second coat. At Contractor's option, one coat may be applied before substantial completion, with a second coat delayed for 3-6 months until weather conditions are appropriate and the concrete has cured sufficiently for proper adhesion.
 - 1. Two coat system total wet mil thickness of 0.015 in (0.381 mm).
 - 2. Two coat system total wet mil thickness of 0.018 to 0.025 in (0.457 – 0.635 mm) When Type IVA beads are used.
 - 3. Two coat system total wet mil thickness of 0.015 to 0.018 in (0.381 – 0.457 mm) When Type IVB beads are used.
- B. Apply painting and finishing materials in accordance with manufacturer's directions. Use applications and techniques best suited for material and surfaces to which applied. Minimum air

shall be used to prevent overspray. Temperature during application shall be minimum of 40° F and rising, unless manufacturer requires higher minimum temperature. Maximum relative humidity shall be as required by manufacturer.

- C. Application of beads shall coincide with application of paint, but shall be done as separate operation by a suitable dispenser. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made.
- D. All lines shall be straight, true, and sharp without fuzzy edges, overspray or non-uniform application. Corners shall be at right angles, unless shown otherwise, with no overlaps. Line width shall be uniform (-0%, +5% from specified width). No excessive humping (more material in middle than at edges or vice versa).

3.4 APPLICATION OF TEMPORARY PAVEMENT MARKING

- A. Temporary pavement markings shall be preformed tape, conforming to ASTM D4592, type 1, removable.
- B. Temporary pavement markings shall be applied after paving, but before being opened to traffic and parking. Markings that are improperly applied and come loose shall be replaced at Contractor's expense, as directed by Engineer.
- C. Temporary pavement markings on finished pavement surface shall be installed allowing for lateral tolerance of ± 2 in. center to center. Temporary pavement markings that are installed outside specified lateral tolerances shall be removed and replaced, as directed by Engineer, at Contractor's expense.
- D. All marking shall have width of 4 inches, unless otherwise specified. Markings shall be either yellow or white per Contract Drawings.
- E. Apply and remove preformed tape per manufacturer's instructions.
- F. Remove all temporary pavement markings prior to placing permanent pavement markings.

END OF SECTION 099120

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SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: The following types of signs:
 - 1. Reflective vehicular directional and information signs (V- Signs).
 - 2. Retroreflective regulatory signs (R- Signs).
 - 3. Non-reflective pedestrian directional and informational signs (PP- Signs).
 - 4. Pedestrian Supergraphic Signs (PS- Signs).
 - 5. PVC Pipe Clearance Signs (PVC- Signs).
 - 6. Brailled ADA Compliant Identification Signs (A-Signs).
 - 7. Dimensional Characters (D-Signs).
 - 8. Traffic Controller Signs (TC- Signs).
- B. Related Sections:
 - 1. Division 01 Section "Temporary Facilities & Controls" for temporary project identification signs.
 - 2. Division 09 Sections "Exterior Painting" or "Interior Painting" for painting by others of surfaces to which signs specified herein may be applied. Painting of signs is included in this Section.
 - 3. Division 23 Section "Common Work Results for HVAC" for labels, tags, and nameplates for mechanical equipment.
 - 4. Division 26 Section "Common Work Results for Electrical Transmissions, Lighting, and Control Devices" for labels, tags, and nameplates for electrical equipment. (Room destination signage is included herein.)
 - 5. Division 26 Section "Interior Lighting" for illuminated exit signs.
 - 6. Division 26 Sections for electrical service and connections for electrified and/or illuminated signs and/or letters.

1.3 SUBMITTALS

- A. General: Submit following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show mounting

methods, mounting heights, anchors, grounds, reinforcement, accessories, layout, spacing, dimensions, and installation details.

1. Provide message list, typestyles, graphic elements, including tactile characters and Braille and artwork as shown on drawings, and layout of lettering. Include large scale details of sign layout.
 2. Wiring Diagrams from manufacturer of electrified signs for power, signal, and control wiring.
- D. Samples: Provide following samples of each sign component for verification of compliance with requirements indicated.
1. Samples of each sign material type (V-, R-, PP-, etc), on not less than 6-in. squares of extrusion, sheet or plate, showing full range of colors to be provided.
 2. Brailled Copy: Sample of ADA compliant sign showing raised image text, brailled copy and colors.
- E. Maintenance Data: For signage cleaning and maintenance requirements to be included in maintenance manual.
- F. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner will in turn reimburse Engineer.
- G. Requests For Information:
1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
 2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the Contract Documents.

1.4 QUALITY ASSURANCE

- A. Qualifications: Manufacturers: Only pre-approved manufacturers as listed herein allowed. Sign manufacturer shall have completed a minimum of 3 projects in last 3 years with similar materials and methods of manufacture as required for this project.
- B. Where warranties are required, manufacturer and/or installers shall be authorized by the entity providing the warranty.
- C. All completed signs shall be free from defects in materials and workmanship and effectively present specified or permitted message under both day and night viewing conditions. Sign faces shall be reasonably smooth, shall exhibit uniform color and brightness over entire background surface and shall not appear mottled, streaked, or stained when viewed either in ordinary daylight or incidental beams of automobile headlamps.

- D. Support structures for signs that are free-standing or extending from any exterior surface of the building, including but not limited to the roof level parking signs on cantilever supports, shall be designed by a licensed professional engineer in the State of North Carolina in accordance with ASCE 7-98's requirements for wind loads.
- E. Internally illuminated or electrified sign cases (TC-): Housing shall be waterproof and shall comply with NEMA Standards Publication 250-Enclosures for Electrical Equipment, for Type 4 enclosures.
- F. Electrical Components, Devices, and Accessories: All components shall be listed and labeled by UL and shall comply with NEMA and NFPA standards.
- G. Electrical Service: Sign contractor shall review electrical drawings and coordinate with electrical contractor for any minor changes to design and installation of equipment and/or electrical service for powering signs and/or illumination thereof. If change order(s) are possible, use the Request for Information process.
- H. Regulatory Requirements:
 - 1. Comply with Americans with Disabilities Act (ADA) and state and local codes as adopted by authorities having jurisdiction. Signs affected, may include, but not be limited to:
 - a. Illuminated Exit Signs: Refer to Division 26.
 - b. Permanently Designated Rooms and Spaces: A- Signs.
 - c. Elevator Signs.
 - d. Stairway Identification.
 - 2. MUTCD:
 - a. Regulatory R- signs shall be fully compliant with all requirements of the Manual on Uniform Traffic Control Devices (MUTCD) except that sign size may be modified due to space constraints.
- I. Single-Source Responsibility: For each separate required type of sign as defined herein, obtain signs from a single firm specializing in this type of work so that there will be undivided responsibility for such work.
- J. Design Criteria: Drawings indicate sizes, profiles, and dimensional requirements of signs. Other signs with deviations from indicated dimensions and profiles may be considered, provided deviations do not change design concept. Burden of proof of equality is on proposer.
- K. Coordinate sign placement with structural configuration and lighting location. Before sign installation, arrange meeting with Engineer/Architect and lighting installer at site to review sign placement. Additional compensation not allowed for relocating signs after installation if relocation required due to conflicts with lighting or structure.
- L. Trade Names: Do not display manufacturer's name, trade name, trademarks, or similar markings on exterior or visible surfaces.
- M. Sign Quantity Count: Sign Fabricator shall be responsible for determining the final quantity count of all signs, as indicated on the Signage Schedule and Location Plans, prior to fabrication.

- N. Provide written 5-year full replacement warranty to Owner that all signage will be free of defects due to workmanship and materials including, but not limited to, fading, peeling, delamination, and installation. With no additional cost to Owner, repair all defects that develop during warranty period and all damage to other Work due to such defects. NOTE: Additional warranties apply to specific sign types and products, as specified herein.
- O. Finishes Warranty: Submit five-year written warranty, signed by the Contractor and Installer, warranting that the architectural signage finishes will not develop excessive fading or excessive non-uniformity of color or shade and will not crack, peel, pit or corrode or otherwise fail as a result in defects, within the warranty period, make necessary repairs or replacement at the convenience of the owner or facility's management.
 - 1. "Excessive Fading": A change in appearance which is perceptible and objectionable as determined by the Designer when visually compared with the original color range standards.
 - 2. "Excessive Non-Uniformity": Non-Uniform fading during the period of the guarantee, to the extent that adjacent panels have a color difference greater than the original acceptance range of color.
 - 3. "Will Not Pit or Otherwise Corrode": No Pitting or other type of corrosion discernible from a distance of 10'-0", resulting from the natural elements in the atmosphere at the project site.
- P. Replacement or Repairs: The owner or facilities management shall have the right to continue use of the defective part until such time that the part is replaced or repaired without loss or inconvenience to the owner or facility's management. Warranties shall also state that the replaced or repaired part shall have a warranty period equal to the remaining warranty period for the replaced or repaired part plus an additional one year.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting and mounting. Where sizes of signs may be affected by dimensions of surfaces on which they are installed, verify dimensions by field measurement. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.6 COORDINATION

- A. For signs to be supported by or anchored to permanent construction, provide installers with specific requirements for anchorage devices. Furnish templates for installation.
- B. Coordinate location of remote transformers with building construction. Ensure that transformers are accessible after completion of work.

1.7 MAINTENANCE

- A. Maintenance Instruction: Furnish maintenance manual to instruct the owner or facility's management personnel in procedures to be followed in cleaning and maintaining the signage.

Provide manufacturer's brochures describing the actual materials used in the work, including metal alloys and finishes.

1. Include a list of cleaning materials appropriate for continued cleaning of signs. Include written instructions for proper maintenance, service access, replacement procedures, etc. Include recommended methods for removal of residual adhesives from wall surfaces after removal of adhesive mounted signs.
- B. Extra Materials: Deliver to the owner or facility's management in manufacturer's original packaging and store at the project site where directed.
 1. Furnish one quart of each finish paint color for touch-up purposes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Product: Where named products are specified, subject to compliance with requirements specific to this project, provide either named product or an equivalent product by other manufacturers specified.
- B. Manufacturers: Subject to compliance with requirements specific to this project, accepted manufacturers listed in Part 2 are considered to have been prequalified in conformance with paragraph 1.4.A and B of this section. Acceptable manufacturers include, but are not limited to, the following:
 1. Manufacturers of panel signs, including V-, R-, PP-, PS-, and D- signs:
 - a. APCO Graphics, Inc.
 - b. Architectural Graphics, Inc.
 - c. ASI Sign Systems, Inc.
 - d. Interstate Highway Sign Corp.
 - e. Henry Graphics.
 - f. Britten Studios.
 - g. Pannier Graphics.
 - h. Tapco.
 - i. Vomar.
 - j. Signs + Decal Corp., Brooklyn, NY.
 - k. Takeform, Medina, NY.
 2. Manufacturers of Brailled Signs (A-):
 - a. Supersine Company.
 - b. APCO Graphics, Inc.
 - c. ASI Sign Systems, Inc.
 - d. Jet Signs.
 - e. Britten Studios.
 - f. Signs + Decal Corp., Brooklyn, NY.
 - g. Vomar.
 - h. Takeform, Medina, NY.

3. Manufacturers of TC- signs:
 - a. National Sign & Signal Company.
 - b. Colite Industries, Inc.
 - c. Daktronics.
 - d. Signal Tech (formerly Howard Industries).
 - e. 3M Dynamic Message Signs (formerly American Electronic Sign).
 - f. Tapco.

2.2 MATERIALS

A. Graphics:

1. Graphics shall be highest quality with sharp lines and smooth curves. Images shall be uniform colors and free from streaks or spotting.
2. Content and Style: Provide sign copy that complies with requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices. Notations contained within parenthesis () in the sign schedule and instructions for logos or symbols that are to be included on the sign, as shown on the design drawings. Refer to the sign schedule for copy, description of signs, and reference to sign types.
 - a. Where reflective messages are specified or permitted to be reverse silk-screened with a non-reflective, opaque background, the sheeting material shall be 3M Scotchlite Engineer Grade Reflective Sheeting Series 3200 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type II, Section 718.01.
 - b. Where reflective messages are specified or permitted to be reverse silk-screened with a reflective, transparent background, the sheeting material shall be 3M Scotchlite High Intensity Grade Sheeting Series 3930 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01.
3. Pressure applied graphics:
 - a. Where pressure-applied graphics applied to a painted background are specified or permitted, the paint shall be flat, opaque acrylic polyurethane as recommended by manufacturer of substrate and graphic media.
 - b. Where pressure-applied, reflective graphics on an opaque painted background are specified or permitted, letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electrocut Engineer Grade Sheeting Series 3260 material, colors as noted on drawings or equivalent. Edges shall be sealed per manufacturer recommendation.
 - c. Where pressure-applied, reflective graphics on a reflective background are specified or permitted, the sheeting material shall be 3930 Hi Intensity Prismatic or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01. The letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electronic Cuttable Film Series 1170, colors as noted on drawings or equivalent.
 - d. Where pressure-applied, non-reflective graphics are specified, letters shall be digitally produced, and cut by computer-driven processes from 3M Scotchlite Electrocut 7725 film.

- e. Where electronically cut letters and symbols are specified, the inside corners shall be rounded using the largest radius consistent with acceptable appearance. Minimum radius shall be 1/8 inch on a 3 inch letter. Use pre-spacing tape as recommended by manufacturer of sheeting as a carrier for letters, numerals and symbols.
- 4. Digital Imaging: Where digital imaging for original art and multicolored graphics are specified.
 - a. Where first surface, reflective graphics are specified, the image shall be electronically produced and electrostatically printed onto the transfer media and then heat transferred onto 3M Scotchlite Plus Sheeting Series 680 using IJ680-10 technology. Image to be protected with 3M recommended graphic protective clear coating. Not to be used for regulatory signs.
 - b. Where first surface non-reflective graphics are required, the image shall be electronically produced and electrostatically printed onto the transfer media and then heat transferred onto 3M Scotchprint flexible reflective graphic film IJ180-10 technology. Image to be protected with 3M recommended graphic protective clear coating.
 - c. Where second surface, non-reflective graphics are required, the image shall be produced using 3M Scotchprint Electronic Graphics System using Scotchcal 7725 marking film and lamination.
- 5. Where specified, dry film transfer shall be produced digitally using computer-driven Dry Thermal Transfer system over 3M high intensity reflective vinyl substrates.
- 6. All products specified to employ 3M sheeting, films, or other components shall be guaranteed and backed by 3M MCS Warranty or equivalent.

B. Inks and Paints:

- 1. All inks and paints shall be a type made for surface material to which it is applied, and recommended by manufacturer. Exact identification shall be noted on shop drawings, with data describing application method, if other than air-drying. Prohibited: paint or ink that will fade, discolor, or delaminate due to UV or heat exposure.
- 2. All colors for which color match specified shall be approved by Engineer prior to production.
- 3. Acceptable manufacturers and suppliers of inks for silk-screening shall be only those materials recommended by the manufacturer of the sheeting and as required for 3M MCS warranty, or equivalent, where applicable.
- 4. Paints: All materials best quality. Products of DuPont DeNemours & Company, Pittsburgh Plate Glass Company, Glidden, Matthews or Sherwin-Williams acceptable.
 - a. Opaque background for pressure applied graphics: Two-part acrylic polyurethane, low gloss. Care shall be taken to provide proper curing so that outgassing does not occur after application of sheeting and/or graphics.
 - b. Painted graphics on steel doors: Refer to Painting specification section 09910.3.6.C. Ferrous metal paint selection for door base. Graphics paint to be compatible with base paint.
 - c. Base for painted graphics on concrete, stucco, masonry and concrete masonry units to be prepared per Paint specifications. Graphics two-part acrylic polyurethane, low gloss.
 - d. High gloss enamel base: Graphics medium to be determined by installer and approved by Architect/Engineer. Primer may be required.

5. Applied color whether ink or paint shall conform to color and accelerated weathering requirements of FP-79 and shall not be removable when tested by Film Adhesion Test and by Film Hardness Test.
- C. Blank Panels: Comply with requirements indicated for materials, thickness, finish, color, design, shape, size, and details of construction.
1. General:
 - a. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 0.0625 in. measured diagonally.
 - b. The back side and edges of all panel signs shall be painted with acrylic polyurethane, color to match the specified background color.
 - c. Edge Condition: Square cut.
 - d. Corner Condition: Square cut for all signs except Regulatory and Warning signs. Regulatory and Warning sign corners shall be rounded per MUTCD.
 2. Fiberglass reinforced plastic (FRP) panels.
 - a. Panels shall be manufactured of clear resin or UV stabilized, acrylic-modified polyester resin reinforced with high solubility, chopped strand fiberglass mat. Glass fibers shall not be readily discernable on sign face. In addition, sign shall have a glass content of no less than 28% of total sign weight. FRP panels which outgas and cause bubbling of sheeting will not be accepted. Sign shall meet following:
 - 1) Ambient temperature range of -50° F to +300° F.
 - 2) Minimum Barcol hardness of 50, tensile strength of 12,000 psi, compressive strength of 20000 psi and flexural strength of 18000 psi.
 - 3) Minimum impact strength of 6 ft lbs/in notch with fire resistance of 500 degree F.
 3. Aluminum:
 - a. Provide aluminum sheet of 6061-T6 or 5052-H38 alloys and temper recommended by aluminum producer or finisher for use type and finish indicated, and with not less than strength and durability properties specified in ASTM B209 for 5005-H15.
 - b. Aluminum extrusions shall be of alloy and temper recommended by aluminum producer for type of use and finish and with not less than strength and durability properties specified in ASTM B221 for 6063-T5.
 - c. Panels shall be etched, degreased, flat, and free of ragged edges. Radius corners by stamping. All signs of same size shall be totally uniform in size. Surface shall be completely clear of dust and dirt before finishes applied.
 - d. Panels to receive 3M sheeting and/or paint shall be treated with an anodizing conversion coating to provide resistance to corrosion and white rust formation. Conversion coating may be:
 - 1) Chromate, meeting ASTM B449 class 2. Coating weight should be 10 to 35 mg per sq ft with a median of 25 mg per square foot. Coating shall not be dusty and shall be tightly bonded within itself and to the aluminum substrate.
 - 2) Non-chromate coatings must meet the requirements for ASTM B449 class 1 chromate coatings. The non-chrome coating shall be adherent and non-powdery. Adhesion of air dried acrylic coating shall meet ASTM D 3359 or ASTM D 4541 and must be equivalent to that of the coating on chromate coated aluminum of the same alloy.

- e. Fabricate aluminum signs with adequately sized, full-length stiffener members as indicated on Drawings.
4. ACM (Aluminum Composite Material)
- a. Provide aluminum composite material panels, one or both sides platinum white stove-lacquered or one side metallic-aluminum, reverse mill finish.
 - 1) Outer layers are aluminum; inner core is polyethylene.
 - b. Provide sign panels with overall thickness in accordance with the following minimums:
 - 1) Wall or Column surface mounted signs: 3mm (0.12").
 - 2) Overhead signs less than 5'-0" long: 4mm (0.15").
 - 3) Overhead signs greater than 5'-0" long: 6mm (0.23").
 - c. Product shall be compatible with temperature ranges varying from -50°C to +80°C.
 - d. Product shall have a minimum modulus of elasticity of 70,000 N/mm².
 - e. Product shall have water absorption in % according to Din 53 495-0, 01.
 - f. Product shall have linear thermal expansion dimensional change of 2.4 mm/m at 100k temperature difference.
- D. V- Signs: Vehicular signs with retroreflective graphics and message on an opaque background.
- 1. Base materials:
 - a. Aluminum with pressure-applied retroreflective letters.
 - b. ACP with pressure applied retroreflective letters.
 - c. FRP with painted background and pressure applied retroreflective letters.
 - 2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed.
 - a. Pressure applied retroreflective white letters/symbols. Use 3M High Intensity Prismatic White Sheeting 3930.
- E. R- Regulatory vehicular signs with retroreflective graphics and message on a retroreflective background.
- 1. All regulatory and warning signs to fully comply with MUTCD standards.
 - 2. Base material: Aluminum.
 - 3. Signs shall have retroreflective messages and retroreflective background using pressure applied retroreflective letters and symbols.
 - 4. Retroreflective colors determined by 23 CFR Appendix to Subpart F of Part 655, Alternate Method to Determining the Color of Retro-reflective Sign Materials and pavement marking materials.
 - a. Federal Highway Authority (FHWA) Reflective Sheeting Identification Guide using ASTM D 4956-04.
 - b. Sheeting Types I through IX.
 - c. The daytime color of non-fluorescent retroreflective materials may be measured in accordance with ASTM Method E 1349, Standard Test Method for Reflectance Factor and Color by Spectrophotometry using Bi-directional Geometry of ASTM Test Method E 1347. Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry.

- d. The geometric conditions to be used in both test methods are 0/45 or 45/0 circumferential illumination or viewing. The CIE standard illuminant used in computing the colorimetric coordinates shall be D 65.
- e. For fluorescent retroreflective materials ASTM E991 may be used to determine the chromaticity provided that the D65 illumination meets the requirements for E 991.
- f. The following 3M Diamond Grade DG³ Reflective Sheeting materials meet the MUTCD retroreflective requirements:
 - 1) White – DG34090
 - 2) Red – DG³ 4092
 - 3) Blue – DG³ 4095
 - 4) Yellow – DG³ 4091
 - 5) Green – DG³ 4097
 - 6) Fluorescent Yellow – DG³ 4081
 - 7) Fluorescent Yellow Green – DG³ 4083
 - 8) Fluorescent Orange - DG³ 4084

F. PP- Signs: Pedestrian Panel Wayfinding and Directional Signs.

- 1. Base materials:
 - a. Aluminum with pressure-applied letters and graphics.
 - b. ACM with pressure applied letters and graphics.
 - c. FRP with painted background and pressure applied letters.
- 2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed:
 - a. Pressure applied non-reflective letters/symbols.
 - b. Original art and/or multi-color graphics shall be digitally produced on graphic media.

G. PS- Signs: Supergraphics, Pedestrian Wayfinding and Directional Signs:

- 1. Painted Super-Graphics: Where graphics painted directly on walls, doors or other surfaces are specified, message template to be:
 - a. Pressure applied electronically cut graphics.
 - b. Adhesive masking paper with digitized characters.
- 2. Apply primer and/or background color as specified on the drawings to surface as required. Sign contractor shall assure that paint employed for graphics is compatible with surface treatment(s) by others, including but not limited to concrete sealers and/or form release agents.

H. PVC- Signs: PVC pipe clearance signs shall have pressure applied decals on black PVC pipe, rectangular retroreflective yellow base sticker 3M Diamond Grade yellow sheeting DG³ 4091 with black border, rounded corners, and black text. See drawings.

- 1. Electronically cut letters: 3M Scotchlite 3840 reflective sheeting.
- 2. 10 in. diameter, Schedule 40 PVC pipe, Corrosion Fluid Products Corporation, Addison, IL, or accepted equivalent. Color black.
- 3. If black PVC is not available, Paint: "Spraylat" Lacryl B No. 482 High Hiding Black. Meet Lacryl system specifications for painting on PVC.

- I. A- Signs: All signs required to be brailled in compliance with ADA requirements for designating permanent rooms and spaces shall comply with ADA Accessibility Guidelines (ADAAG) as published by the Architectural and Transportation Barriers Compliance Board and ICC/ANSI A117.1. latest editions.
 - 1. Aluminum:
 - a. Text to be produced with die-cut raised letters and brailled copy.
 - 2. Phenolic-Backed Photopolymer Sheet. Provide light sensitive, water-wash photopolymer face layer bonded to a phenolic base layer to produce composite sheet with overall thickness of 0.15 inches, and substrate thickness of 0.12 inches and a Type D Shore Durometer hardness of 95.
 - 3. Lettering and Grade II brailled to be raised 1/32". Lettering to be painted white matte finish. Grade II brailled to be painted out with matte finish background in color shown on drawings. Edges painted same as face.
 - 4. Produce precisely formed characters with square cut edges free from burrs and cut marks.
 - 5. Fasteners shall be mechanical, concealed and tamper proof.
- J. Dimensional Characters (D-Signs):
 - 1. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated. Finish shall be color anodic finish, integrally colored or electrolytically deposited color coating, 0.018 mm or thicker in color specified on schedule, with a satin mechanical finish.
 - 2. Cast Acrylic Sheet: Acrylite FF or equivalent. Cut characters from solid plate.
 - 3. Characters shall have smooth flat faces, sharp corners and precisely formed lines and profiles, free from pits scale, sand holes and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs.
 - 4. Illuminated characters: Illuminate characters in manner indicated using manufacturer's standard lighting components, including light source, transformers, insulators and other components. Make provisions for servicing and concealing connections to building electrical system.
 - a. Back-lighted characters: Provide concealed [neon tubes, fiber optics] required by size of characters. Include manufacturer's hardware for projection mounting of characters at distance from wall surface indicated.
 - b. Face-lighted characters: Fabricate character faces from translucent acrylic sheet of thickness indicated. Attach characters to sheet metal back channels. Provide lighting tubes of number and spacing required to illuminate sign faces evenly.
- K. Illuminated Traffic Controller Signs (TC- Signs):
 - 1. Illuminated traffic control signs shall be Signal Tech LED controller or equivalent. Traffic arrows shall be TCL1212 series; open/closed or full messages shall be TCL718 series.
 - 2. Display technology shall be super bright LED using aluminum gallium indium phosphide (ALGaInP) diodes. Viewing angle shall be 70 degrees.
 - 3. Provide for automatic control from PARCS system computer with individual manual override operator control switches located in parking office. In addition, provide additional manual override switches in cashier booth nearest lane controlled.
- L. Fasteners and Supports:

1. Bolts, nylon insert lock nuts: ASTM A 320, Grade B stainless steel.
2. Rivets for signs: ASTM B 316, Alloy 6063-T61 or equivalent. Aluminum alloy blind rivets of self-plugging variety may be substituted for solid aluminum alloy rivets, subject to acceptance by Engineer/Architect.
3. Use concealed fasteners fabricated from metals not corrosive to sign material and mounting surface.
4. Anchors and Inserts: Use nonferrous metal or hot dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
5. Sign posts: ASTM A 499 Grade 60 or ASTM A 576, Grade 1080 and meeting mechanical properties specified in ASTM A 499 for Grade 60 steel.
6. Posts shall be zinc coated per ASTM A 123. Posts shall be straight, with smooth, uniform finish, free from defects affecting strength, durability, or appearance. Punch bolt holes such that post face shall be smooth and even. All holes and ends shall be burr free. After all fabrication, flow coat posts with durable, exterior type, rust inhibiting paint. Paint color: black, unless otherwise indicated on drawings.
7. Adhesives, where used for wall mounted signs, shall be Loctite PL Premium Construction Adhesive with a bond strength of >100 lbs. per 2 square feet, or approved equal. Adhesive application install temperature shall be between 42°F to 94°F. Adhesive properties shall be, but not limited to the following: Low VOC, waterproof, paintable, non-flammable and Greenguard certified. Allow 24 hours for adhesive to cure.
8. For ACM signs, fasteners and mountings shall follow manufacturer's recommendations. Minimum edge distance of 0.75" or 2.5 times the diameter of the fastener being used is recommended as the distance from the center of the hole to the edge of the panel. Large flat washers shall be used to prevent crushing of the sign material.

M. Cantilever Sign Supports:

1. Pipe for poles and arms: Steel pipe, ASTM A53, Grade B, Type E or S.
2. Gusset, flange, and base plates: ASTM A 36.
3. Castings: Free of sharp edges and irregularities. Pole top and end cap castings: ASTM A 126, Class A.
4. Bolts: Connect arm connection flanges with galvanized high strength steel bolts, nuts, and washers per ASTM A 325. Hot dip galvanized fasteners per ASTM A 153. Galvanized nuts shall be tapped oversized per ASTM A 563, and Supplementary requirement S1, "Lubricant and Test for Coated Nuts."
5. Welding: Applicable requirements of Sections of Division 05.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION OF SUBSTRATE FOR PAINTED SIGNS

- A. Prepare and clean in strict accordance with paint manufacturer's instructions and as specified here, for each substrate condition.
- B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so contaminants from cleaning process will not fall onto wet, newly painted surfaces.

C. Cementitious Surfaces:

1. Prepare surfaces to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and, by roughening as required, glaze.
2. Determine alkalinity and moisture content of surfaces to be painted by appropriate testing. If surfaces found to be sufficiently alkaline to cause blistering and burring of finish paint, correct before painting. Do not paint on surfaces with moisture content exceeds manufacturer's limits.

- D. Ferrous Metals: Clean uncoated ferrous surfaces of oil, grease, dirt, loose mill scale, and other foreign substances by solvent or mechanical cleaning. Clean previously coated metals in accordance with manufacturer recommendation.

3.2 MATERIALS PREPARATION FOR PAINTED SIGNS

- A. Mix and prepare painting materials per manufacturer's directions.
- B. Store materials not in use in tightly covered containers. Keep all containers clean, free of foreign materials and residue.
- C. Stir materials before applying to produce uniform mixture, and stir as required during application. Do not stir surface film into material. Remove film and strain material before using if necessary.

3.3 INSTALLATION

- A. General: Locate signs where shown using mounting methods of type described and in compliance with manufacturer's instructions. Install sign units level, plumb, and at height shown, with sign surfaces free from appearance defects.
- B. For drilled anchors in concrete, verify location of embedded reinforcing steel, or pre-stressing cables prior to installation.
- C. Wall Mounted Panel Signs: Attach to wall surfaces with Hilti "Hit" anchors or ITW Ramset/Red Head Hammer Set anchors into concrete or masonry surfaces as shown on Drawings. DO NOT OVERDRIVE anchors, as overdriven anchors will damage sign faces and spall concrete.
- D. Bracket Mounted Units: Provide manufacturer's standard brackets, fittings, and hardware as appropriate for mounting signs which project at right angles from walls or ceilings. Attach brackets securely to walls or ceilings with concealed fasteners and anchors per manufacturer's directions.
- E. Installation of signs shall conform to requirements of Americans with Disabilities Act (ADA) and/or state or local accessibility standards.

3.4 CLEANING AND PROTECTION

- A. At completion of installation, clean soiled sign surfaces in accordance with manufacturer's instructions. Protect units from damage until acceptance by Owner.

- B. Cleanup: During progress of Work, remove from site all discarded materials and rubbish at end of each day.
- C. Upon completion of painting, clean all paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- D. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing. Correct any damage by cleaning, repairing, or replacing, and repainting, as acceptable to Engineer/Architect.
- E. Provide "Wet Paint" signs as required.

END OF SECTION 101400

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SECTION 104400 - FIRE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Portable fire extinguishers.
 - 2. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.
 - 3. Mounting brackets for fire extinguishers.

1.2 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Verification: For each type of exposed factory-applied color finish required for fire-protection cabinets, prepared on samples of size indicated below.
 - 1. Size: 6 by 6 inches (150 by 150 mm) square.
- C. Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304.
- B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 PORTABLE FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. Buckeye Fire Equipment Company.
 - 2. JL Industries, Inc.
 - 3. Kidde Fyrnetics.
 - 4. Larsen's Manufacturing Company. (Basis of Design)
 - 5. Potter Roemer; Div. of Smith Industries, Inc.
- B. General: Provide fire extinguishers of type, size, and capacity for each mounting bracket indicated.
 - 1. Handles and Levers: Manufacturer's standard.
 - 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

- C. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10 lb (4-A:60-B:C, 4.5 kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.4 FIRE-PROTECTION CABINET

- A. Basis-of-Design Product: Model No. SS 2409-SM manufactured by Larsen's Manufacturing Company or a comparable product by one of the following:
 - 1. General Accessory Mfg. Co.
 - 2. JL Industries, Inc.
 - 3. Kidde Fyrnetics.
 - 4. Larsen's Manufacturing Company.
 - 5. Potter Roemer; Div. of Smith Industries, Inc.
- B. Cabinet Type: Suitable for fire extinguisher.
- C. Cabinet Construction: Nonrated.
- D. Cabinet Material: Stainless-steel sheet.
- E. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall; with no trim.
- F. Cabinet Trim Material: Stainless-steel sheet.
- G. Door Material: Stainless-steel sheet.
- H. Door Style: Vertical duo panel with frame.
- I. Door Glazing: Tempered float glass (clear).
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- K. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- L. Finishes:
 - 1. Stainless Steel: No. 4 finish.

2.5 MOUNTING BRACKETS

- A. Available Manufacturers:
 - 1. JL Industries, Inc.
 - 2. Larsen's Manufacturing Company.
 - 3. Potter Roemer; Div. of Smith Industries, Inc.
- B. Mounting Brackets: Manufacturer's standard chromed steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with chrome plated finish.

2.6 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Construct fire-rated cabinets with double walls fabricated from 0.0428 inch (1.1 mm) thick, cold-rolled steel sheet lined with minimum 5/8 inch (16 mm) thick, fire-barrier material.
 - a. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.7 STAINLESS-STEEL FINISHES

- A. General: Remove tool and die marks and stretch lines or blend into finish.
 - 1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Bright, Directional Polish: No. 4 finish.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

- B. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 1. Fire-Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
 - 2. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
 - 1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104400

SECTION 10 76 20 - FLEXIBLE DELINEATOR POSTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Flexible Delineator Posts.
- B. Related Sections:
 - 1. Division 03 Section "Cast-in-Place Concrete"

1.3 SUBMITTALS

- A. Make submittals in accordance with requirements of Division 1 and as specified in this Section.
- B. Product Data: Submit manufacturers' product specifications and installation instructions for each type of flexible delineator post required.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND PRODUCTS

- A. Available Manufacturer and Products: Subject to compliance with requirements, provide one of following:
 - 1. Impact Recovery Systems, Inc., San Antonio, TX: Tuff Post High Performance Channelizer.
 - 2. Bent Manufacturing, Hunt Beach, CA: Masterflex Post, full-view Channelizer, 3¼" diameter.
 - 3. Three D Traffic Works, Inc., Burbank, CA:
 - a. Surface Mount: TD 5200 Boomerang Post, 3" diameter.
 - b. Soil Anchor: Earthflex TD5500 Post, 3" Diameter.
 - 4. Safe Hit Corporation, Hayward, CA: Dura-Post with reflective bands.

2.2 MATERIALS

A. Flexible Post:

1. Design

- a. Delineator post shall be fabricated to withstand repeated impacts.
- b. Post shall incorporate flexible post and utilize reactive spring device to absorb stress from impacting vehicle.
- c. Post and spring assembly shall be mounted on fixed base that will allow replacement of post in not more than 2 minutes.
- d. Post to have reflective tape or paint banding per MUTCD requirements for increased visibility.

2. Materials

- a. Delineator post to be constructed of flexible polyethylene plastic.
- b. Surface of post shall be smooth and suitable for adherence of reflective sheeting.
- c. Mounting: Surface Mount.
- d. Post Height: 42"
- e. Color: Orange

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine areas and conditions under which Work is to occur. Notify Architect immediately in writing as required in General Conditions of all conditions detrimental to proper and timely completion of Work.
- B. Proceed with Work only after unsatisfactory conditions have been acceptably remedied.
- C. Installation per manufacturer's recommendations for specific material to be mounted on.
 - 1. Concrete: Expansion bolts or epoxy mastic.

END OF SECTION 107620

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SECTION 108213 - ARCHITECTURAL SCREENS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Architectural screens and accessories.

1.2 RELATED SECTIONS

- A. Section 079200 - Joint Sealants.

1.3 SUBMITTALS

- A. Product Data: Provide data describing design characteristics, materials and finishes.
- B. Shop Drawings: Indicate screen layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.

1.4 WARRANTY

- A. Provide twenty year manufacturer warranty against distortion, metal degradation, and failure of connections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Architectural Screens:
 - 1. The Airolite Co.
 - 2. Construction Specialties, Inc.
 - 3. Industrial Louvers, Inc.

2.2 MATERIALS

- A. Aluminum extrusions: ASTM B 211, Alloy 6063-T52.
- B. Clip Angles: Structural grade aluminum.
- C. Fastenings: Fasteners shall be stainless steel. Provide types, gauges and lengths to suit unit installation conditions.
- D. Anchors and Inserts: Use stainless steel anchors and inserts for installation. Use stainless steel bolt devices for drilled-in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.3 FABRICATION, GENERAL

- A. Provide grille and accessories of design, materials, sizes, depth, arrangement, and metal thickness as indicated or as required for optimum performance with respect to strength; durability; and uniform appearance.
- B. Include anchorages, and accessories required for complete assembly.

2.4 ALUMINUM FINISH

- A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory after products are assembled. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces which will be visible after completing finishing process.
 - 1. Provide Color as indicated or, if not otherwise indicated, as selected by architect from standard Kynar 500 colors.
- B. Fluorocarbon Coating: Inhibitive thermo-cured primer, 0.2 mil minimum dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500" resin, 1.0 mil minimum dry film thickness.
 - 1. Furnish manufacturer's twenty (20) year guarantee of "Kynar 500" finish.
 - 2. Finish shall be applied in the plant of the manufacturer.

2.5 ACCESSORIES

- A. Flashings: Of same material as screen frame formed to required shape, single length in one piece per location.
- B. Sealant: As specified in Section 079200.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.

3.2 INSTALLATION

- A. Install architectural screen assembly in accordance with manufacturer's instructions.
- B. Install screens level and plumb.
- C. Install flashings and align screen assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure screen frames in openings with concealed fasteners.

3.3 CLEANING

- A. Clean surfaces and components.

END OF SECTION 108213

SECTION 111226.00 – PARKING ACCESS CONTROL SYSTEM (PACS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. This Section and associated Related Sections listed below include the design, fabrication, and installation of a Parking Access Control System (PACS).
 - 2. The new system shall have ability to communicate with the existing parking access control system currently in use by the University.

- B. Related Sections:

- 1. 111226.01 System Description for general information.
 - 2. 111226.02 Facility Management System for project requirements.
 - 3. 111226.03 Control Gates & Vehicle Detectors for project requirements.
 - 4. 111226.04 Access Control System for project requirements.
 - 5. 111226.07 Intercom System for project requirements.
 - 6. 111226.08 License Plate Recognition (LPR) System for project requirements.

- C. Related Requirements: The following Divisions and Sections contain requirements that relate to this Section:

- 1. Division 03 Section, "Cast-in-Place Concrete" for anchoring requirements.
 - 2. Division 05 Section, "Metal Fabrications" for pipe bollards to protect equipment.
 - 3. Division 10 Section, "Signage" for traffic control and variable message signs.
 - 4. Division 26 Section, "Electrical" for power, conduit, and wiring requirements.

1.3 REFERENCES

- A. Abbreviations

- 1. ACS Access Control System
 - 2. CCS Count Control System
 - 3. DLT Digital Linear Tape
 - 4. ES Entry Station
 - 5. FAT Factory Acceptance Test
 - 6. FMS Facility Management System
 - 7. ID Identification

- | | | |
|-----|------|---|
| 8. | LAT | Lane Acceptance Test |
| 9. | LPR | License Plate Recognition |
| 10. | NEMA | National Electrical Manufacturing Association |
| 11. | PACS | Parking Access Control System |
| 12. | RAID | Redundant Array of Independent Disks |
| 13. | RF | Radio Frequency |
| 14. | SAT | System Acceptance Test |
| 15. | UPS | Uninterruptible Power Supply |
| 16. | XS | Exit Station |

B. Definitions

1. Credential: ACS device, used to grant access and egress from parking facility.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Distribute the following to those whose work is related:
 - a. Installation diagrams, details, and templates for setting mounted equipment.
 - b. Templates and cast-in inserts to anchor freestanding equipment to curbs and bases.
 - c. Electrical wiring diagrams and details.
 - d. Electrical installation requirements.
 - e. Electrical power requirements.
2. Confirm layout of conduits, stubs, vehicle detectors, inductive loops, bollards, and anchor bolts.
3. Terminate and connect all communications cabling. Install all Contractor supplied equipment and the interconnection with Owner supplied equipment. Furnish and install all modems, electronics, and equipment for communication network.
4. Test and adjust circuits prior to installation of PACS equipment. Authorize and accept responsibility for application of power to equipment and initiation of operation. Run all initial diagnostics and system testing programs necessary to provide complete working system.

B. Pre-Installation Meeting: Conduct meeting within 30 days of contract award with Owner and Engineer at Project site.

1. Discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
2. Verify equipment operation is consistent with system description.
3. Review submitted schedule for installation of PACS equipment.
4. Review required testing and acceptance procedures.

C. Scheduling:

1. Coordinate installation and testing of equipment so that Owner may begin operation of PACS at time parking facility is opened to public for use.
2. Provide seven days' notice to Owner and Engineer/Architect to review completed installation prior to acceptance testing.

3. Substantial Completion: A certificate of substantial completion will be provided when the following requirements have been satisfied:
 - a. All systems have passed Part One of the SAT test as specified in Part 3 of this Section.
 - b. Certification of PCI compliance.
 - c. All spare parts, stock material, and manuals are on site.
 - d. All training is complete.
 - e. All test checklists, documentation, and training evaluation forms have been provided.
4. Final Acceptance: Upon satisfactory completion of all work, tests, demonstrations, and training specified herein as well as completion of Part Two of the SAT test as stipulated in Part 3 of this Section.

1.5 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated:
 - a. Construction details, material descriptions, dimensions, and finishes.
 - b. Rated capacities, operating characteristics, and electrical characteristics.
2. For FMS software and associated hardware:
 - a. Configuration diagram.
 - b. Software platforms and programming language.
 - c. Communication protocol, polling procedures, and transaction message flow from peripheral devices to and through FMS.
 - d. Communication failure/error identification and recovery.
 - e. Fault tolerance.
 - f. Back-up procedures.

B. Shop Drawings: For parking control equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, required clearances, and location and size of each field connection.
2. Wiring diagrams: For power and control wiring. Diagrams shall clearly indicate wiring not installed by PACS installer.

C. Samples:

1. Equipment finishes.
2. ACS ID device.
3. RCS Credential.
4. Standard reports.

D. Acceptance Testing Plan: Include three copies of checklists which detail tests for every functional requirement of each piece of equipment. Identify acceptance criteria and acceptable tolerances for test results. Define all test objectives, participant responsibilities, and procedures for dealing with failures during test.

- E. Training Program: Include a general description of each course, facility and equipment requirements, instructor resumes, and student feedback forms 30 days prior to scheduled training sessions.
- F. Submittals and Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner will in turn reimburse Engineer.
- G. Requests For Information:
 - 1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
 - 2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
 - 3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

- A. Detailed schedule of project requirements including milestones for shop drawings, fabrication, delivery, installation, testing, training, and substantial completion within 30 days after award of contract. Milestones shall also include special project requirements related to coordination with work by others and phasing.
- B. Location and type of phone lines needed for credit card processing system within 30 days after award of contract.
- C. Qualification data listed in "Quality Assurance" of this Section for Manufacturer(s) and Installer(s) of each primary component. For the three most recently installed, complete projects that are similar in magnitude, complexity, and dollar value, include names, locations, contacts, telephone numbers, date of installation, number of lanes in facility, and description of types and quantities of equipment.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Service Contract: Optional service agreement specified in this Section.
- B. Operating Data: Prior to initiation of field test and training, deliver operations manuals, maintenance, and administration manuals in number as specified below. All manuals shall be supplied for the system as specified and installed. Generic manuals covering a range of products are not acceptable.
 - 1. Supervisor Manual: Explain all features and functions of PACS for day-to-day management. Include a section for problems and/or exception conditions so Supervisor can resolve common operating problems. Manual shall also contain instructions on how

- to perform normal maintenance (e.g., changing paper for printer). Manual shall not contain any installation or power explanations. Provide one hard copy and one electronic copy.
2. Maintenance Manual: Include detailed instructions on how to perform regular and preventive maintenance on all components of PACS and communications network that can be performed by Owner's staff. Provide one hard copy and one electronic copy. Manual shall include:
- a. Description of unit and component parts, including complete nomenclature and commercial number of all replaceable parts.
 - b. Operating procedures: Include start-up; break-in; routine and normal operating instruction; regulation, control, stopping, shutdown and emergency instructions; and special operating instructions as applicable.
 - c. Maintenance procedures: Include routine operations; guide to trouble shooting; servicing and lubrication schedule; list of lubricants required; description of sequence of operation; as-installed control diagrams; as-installed color coded piping and wiring diagrams; and a list of spare parts and recommended quantities to be maintained in storage on-site.
 - d. Trouble-shooting guide for repairs that can be performed by Owner's staff.
 - e. Manufacturer's product data with each sheet annotated to clearly identify data applicable to installation and delete references to inapplicable information.
 - f. Drawings necessary to clearly illustrate relations of component parts of equipment and systems.
3. System Administration Manual: Include all procedures necessary for proper monitoring and administration of PACS as might be required by Owner's parking manager. Provide one hard copy and one electronic copy.
- a. Include sections that cover day-to-day operations, modification of field programmable settings, back-up and recovery, audit and control procedures, report production, contingency plans, configuration control, and system diagnostics.
 - b. Include a removable section on proper administration and control of security features built into system. Some of information to be contained in this section includes maintenance of user identifiers, password control, rule maintenance, and security policy review.
- C. Warranty Documentation: One hard copy of manufacturer's warranty include proper procedures in the event of failure and instances that may affect validity of the warranty.
- D. Record Documentation: One hard copy set and one set in AutoCAD format of record drawings with dimensions indicating modifications to the Contract Drawings, conduit locations, and field wiring diagrams.
- E. Software: All licenses, registrations, documentation, disks, and other media as may have been included with those commercially available software packages provided with system.
- 1.8 MAINTENANCE MATERIAL SUBMITTALS
- A. Spare Parts: Furnish spare components and parts as called for in the associated sections, complete and ready to use, prior to commencement of SAT and maintain inventory of spare components at this level as components are used during warranty period.

- B. Stock: Furnish operating stock items as called for in the associated sections prior to commencement of SAT. Owner will provide camera-ready artwork for logos.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturers shall have been continuously in operation for past five years.
2. Manufacturers shall have current version of each primary component currently operating successfully in two or more parking facilities of similar size and activity.
3. Manufacturer shall employ a Quality Management System complying with the program described in ISO 9001-2008, or similar system.
4. If all components of PACS are not from same manufacturer, Contractor shall be responsible for performance of these components, as they relate to proper functioning of complete system as required herein including demonstrating successful performance of proposed system, subsystems, and equipment.
5. System shall incorporate equipment of proven reliability that can be documented from similarly sized installations that provide features and performance comparable to that required herein.

B. Installer Qualifications:

1. Successful installation and maintenance of equipment manufacturer's products for minimum of three years.
2. Written acknowledgement of installation and maintenance qualifications from PACS manufacturer(s).
3. Successful completion of manufacturer's training in the proper installation and maintenance of manufacturer's systems, subsystems, and equipment specified herein.
4. Installer shall employ a Quality Management System complying with the program described in ISO 9001-2008 or similar system.
5. Manufacturer approved equipment service center in sufficient proximity to respond on-site to service calls within four hours.

- C. Licensed Professionals: When required by jurisdictional authorities, engage licensed professionals who shall apply their professional seal and sign those design documents, reports, or other materials and work required to be sealed when submitted to Owner, Engineer, or other jurisdictional authorities.

- D. Comply with all applicable State laws, codes and standards, and Americans with Disabilities Act.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment to site packaged to prevent damage and marked for easy identification.
- B. Assume care, custody, and control of all PACS equipment and components.
- C. Store equipment in original containers in clean, dry location designated by Contractor or Owner and agreed to by PACS Installer.
- D. Replace damaged materials at no cost to Owner.

1.11 PROJECT SITE CONDITIONS

- A. PACS components shall operate dependably within ambient conditions indigenous to installed site location. Components located in a 24-hour climate controlled office shall be capable of normal performance in a business environment.

1.12 WARRANTY

- A. Warranty period shall begin after completion of the System Acceptance Test as specified in Part 3 of this Section.
- B. Warrant equipment and installation (100% parts and labor) for period of one year from date of final acceptance by Owner. System shall be maintained and serviced against any and all malfunctions due to manufacturing or installation defects at no cost to Owner during warranty period.
- C. Maintain all software and hardware in specified working order, regardless of whether vendor or third party OEM supplier is still supporting that version/product.
- D. Keep a log of all maintenance and repair work performed under warranty to give to Owner at end of warranty period.
- E. Install all commercially-released software updates, patches, and upgrades applicable to this system that are released during warranty period at no additional cost.
- F. Repair or correct software functions required by specifications, even if undiscovered during testing, commissioning or warranty period, including report formatting and data recovery resulting from software deficiencies at no additional cost.
- G. Limitations: Warranty is not required to cover acts of vandalism, damage caused by third party, or natural phenomena, or damage caused during maintenance actions by untrained/unapproved Owner personnel.
- H. Response Time: During Warranty period, a fully-qualified maintenance technician shall be on site within four (4) hours.

PART 2 - PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

- A. Provide all conduit and wiring which is needed for total system performance but which is not shown on the Contract Documents.
- B. Integration With Existing System: PACS shall have ability to communicate the existing parking access control system currently in use by the University.
- C. Future System Expansion: PACS shall be easily expandable to accommodate additional parking facilities, features, and configurations. Installed PACS shall be capable of adding equipment

D. Equipment Construction

1. All devices shall be ergonomically designed for ease of use by patrons.
 2. Cabinets shall be fabricated of a material that is strong and durable such as, but not limited to, composite, stainless steel, aluminum alloy, or welded 12-gauge steel. Mounting holes shall only be accessible from inside of cabinet. All surfaces shall be corrosion resistant and exterior of cabinet shall be finished in a color chosen by Owner. Provide hinged cabinet doors that swing clear of traffic lane.
 3. Corrosion resistant connection boxes shall be provided for all wiring connections.
 4. Internal components, to the extent practical, shall be modular, plug-in units for easy maintenance and replacement.
 5. Equipment shall incorporate all necessary control logic and communication capability to perform as required herein.
 6. Provide for ease of performance verification and failure detection while minimizing effort required for adjustment.
 7. Provide unobstructed access to equipment components.
- E. Provide a system and components that have a service life of ten years and specify periodic maintenance requirements in maintenance manual to meet that life expectancy.
- F. Substitutions: It is recognized that there are variations in equipment between manufacturers. Where functional performance, features, or quality of the proposed system varies from that specified, submit request for substitution identifying substitution being proposed. This submittal may be accompanied by catalog sheets, brochures, and technical specifications of the proposed system.
- G. Gates shall be capable of individually being raised automatically once upon signal from FMS after power failure and shall be reset manually at gate reset when power is restored.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including equipment bases; accurate placement, pattern, and orientation of anchor bolts; critical dimensions; and other conditions affecting performance of the Work.
- B. Examine location of all equipment and office equipment to determine if there are any constraints or conflicts before office equipment installation.
- C. Examine roughing-in for electrical systems to verify actual locations of connections before parking control equipment installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install PACS in accordance with manufacturer's recommendations and approved Shop Drawings. Equipment layout shall allow proper movement of air through and around equipment.
- B. After completing installation of exposed, factory-finished parking control equipment, inspect exposed finishes and repair damaged finishes.
- C. Remove barrier gate arms during the construction period to prevent damage and install them immediately before Substantial Completion.

3.3 FIELD QUALITY CONTROL

- A. General
 - 1. Generate a document to indicate the passing status of that lane/device. It will only pass the test if all of the established testing criteria have been met.
 - 2. Provide all test and diagnostic equipment including special tools, electronic equipment, meters, laptop computer with appropriate software and communication ports, RF field and signal strength meters, transceivers, etc. necessary to conduct all tests, measure and record results, isolate, diagnose and de-bug deficiencies, and to generate reports and documentation of test results.
 - 3. Provide sufficient number of RCS credentials, properly encoded or prepared to test all specified features, ACS ID devices, currency of all denominations, credit cards and other stock materials and consumables required for all test sequences.
 - 4. Maintain detailed records and logbooks of all system tests, events, and issues. Provide Owner with copies of all records
 - 5. Notify the Owner in writing at least seven days prior to each test session. In event that the first test is not successful, correct noted deficiencies and notify the Owner, at least two days in advance that test session is ready to resume.
 - 6. Inspections and tests observed by Owner and Engineer/Architect shall not relieve Contractor of responsibility for providing hardware, software, and documentation in accordance with this Specification.
- B. Lane Acceptance Test (LAT): Upon completion of installation of PACS equipment at each lane or each piece of pay-on-foot or office equipment, a LAT shall be performed.
 - 1. Test installed equipment and systems at each location to confirm that the components installed are fully operational as specified.
 - 2. Test shall exercise all features and functional performance requirements of equipment in accordance with the specific test procedures required in Part 1 of this section and the requirements of the equipment specific associated Sections.
- C. System Acceptance Test (SAT): The SAT consist of two parts and shall be used to confirm that all the physical, operational, and management features and capabilities specified in the Lane Acceptance Test (LAT) processes are present in the installed integrated system.
 - 1. Part One is performed prior to initial public operation of the system. Verify that the major subsystems and the entire PACS are fully operational as an integrated system and operating properly. Each piece of equipment and subsystem shall be tasked to its specified capabilities.

2. Part Two is performed after initial public operation of the system and is a live operational acceptance test of the system. This portion of the SAT occurs over a minimum period of 30 days.
 - a. If there is an interruption of service due to normal PACS events, such as the insertion of a credential in the wrong slot, a repair will be made and the event logged. This will not constitute a failure of the SAT, which will continue without interruption. Part 2, once successfully completed, serves as the final acceptance test for the system.
 - b. Contractor shall have a qualified and experienced technician on as required during 30-day test. When not on site, technician shall be on call with a one-hour response time. During this period, the following performance standard shall be met in order for final acceptance to be issued:
 - 1) All PACS components shall be fully operational as an integrated system without downtime. For each downtime period of four hours or more, one working day will be added to acceptance cycle.
 - 2) All electronic components shall be operational without downtime or programming problems for complete monthly reporting cycle. For each downtime period of more than one hour but less than eight hours or programming problem that delays report cycle, two working days will be added to acceptance cycle.
3. Complete all installation tests, demonstrations and training appropriate to the equipment installed in each phase prior to the start of the interim SAT for that phase
4. Maintain detailed records and logbooks of all SAT tests, events, and issues and provide Owner with copies of all records.

3.4 TRAINING PROGRAM

- A. Develop and implement a comprehensive training program for Owner's personnel.
- B. Design the curriculum so that each group is trained in the full repertoire of system commands that they use in the course of performing their designated functions. Training shall be accomplished through use of lectures, visual presentations, and operation of equipment. Each trainee shall be provided with a complete set of training materials and operating manuals during training session, which he/she will retain for use on job.
- C. Conduct training at times and locations acceptable to Owner. The trainees shall receive training no more than two weeks prior to their use of the equipment.
- D. After the maintenance training sessions submit to Owner a list naming qualified Owner maintenance personnel. List shall detail level of maintenance/repair functions each person is qualified to perform.
- E. Training shall consist of the following:
 1. Supervisors: Supervisors shall be trained to:
 - a. Perform primary maintenance on PACS components (trouble shoot and replenish supplies).
 - b. Understand any and all system messages provided by FMS, including but not limited to alarm messages, indications of attempts to compromise system, and

- explanations of atypical lane activity displayed by access, revenue, and count control system.
 - c. Correlate credentials issued with vehicles present.
 - d. Understand purpose and data contained within any and all reports produced by FMS.
 - e. Operate FMS.
2. Maintenance personnel: Maintenance personnel shall be certified to troubleshoot all systems and shall be trained to perform primary maintenance on all major components of system. Additionally, maintenance personnel shall be trained to:
- a. Reset system after a power failure.
 - b. Replace internal components as appropriate.
 - c. Lubricate and clean internal components.
 - d. Remove and replace gate arms and adjust gate arm travel.
3. System Managers/Administrators: System Managers/Administrators shall have the same basic training as Supervisors. In addition to such training, System Managers/Administrators shall be trained to operate FMS and to understand statistical reports which reveal trends in revenue generation, facility utilization, and based on information available from FMS, to perform checks and balances over actions of Supervisors and their subordinates. Three and six months after Final Acceptance, System Administrators shall have one day additional training.

3.5 MAINTENANCE SERVICE CONTRACT

- A. Contract: Provide a separately priced option for a five (5) year maintenance and service contract. Contract to start in conjunction with expiration of warranty period. Maintenance and Service Contract shall be priced in one (1) year increments and require annual approval by owner for renewal and continuation of contract. The costs of the Maintenance and Service Contract shall be broken-out by maintenance service function. Pricing shall stipulate hourly labor rates for agreed upon services. Maintenance service functions shall consist of the following:
- 1. Basic Repair: The manufacturer shall train and factory-certify owner personnel to perform all basic manufacturer recommended maintenance and repair functions. This will allow garage personnel the freedom to maintain system without voiding the warranty.
 - 2. Preventive Maintenance: At the outset of agreement the Maintenance Service Contractor shall submit a recommended schedule and task list of preventive maintenance services for the PACS equipment. Preventive maintenance will be performed on a pre-planned schedule by factory certified technicians on the direct payroll of the maintenance service contractor.
 - 3. Emergency Maintenance: Emergency maintenance is classified as support that is necessary to remedy system failures that prevent basic operations of the parking revenue control system. Emergency failures include server malfunctions, credit card system failures or system wide network failures. Emergency maintenance shall be supported by an on-call support team and remote system access capability from the Maintenance Service Contractor.
- B. Maintenance Log: The Maintenance Service Contractor shall maintain a Maintenance Log of all Preventive and Emergency Maintenance services performed during the Maintenance Service Contract. The log should be in an owner approved format and shall be available for inspection by the owner at any time during the period it covers. The Maintenance Log should be kept on a

component-by-component basis with separate sections or volumes as appropriate for each component. The log should itemize the history of preventive and emergency maintenance activities, stating the character, duration, cause, and cure of all malfunctions along with the individual who completed the repair. Additionally, the log will record all hardware and software updates.

- C. Repair: Maintenance Service Contractor shall repair or replace all defective or damaged items by end of following calendar day on which notice was given by Owner. Critical parts maybe serviced on an exchange or loaner basis to minimize downtime. Parts removed from on-site spare parts inventory shall be replaced as soon as practicable after use. If Maintenance Service Contractor is not available, Owner personnel may initiate repairs. Maintenance Service Contractor shall then reimburse Owner for parts and labor necessary to correct deficiencies as defined within maintenance service contract.
- D. Response Time: During Maintenance Contract, a fully-qualified maintenance technician shall be on site within four (4) hours.
- E. PCI Compliance Option: As a separately priced option to the (5) Year Maintenance and Service Contract, the Maintenance Service Contractor shall offer to commission the services of an independent Payment Application Qualified Security Assessor, PA-QSA, as stipulated by the PCI council to certify the system meets all PCI compliance criteria. Initial certification shall be included in the installation price. Pricing shall be itemized for regular 18-24 month recertification as stipulated by PCI data security standards for a period inclusive of 5 years.

END OF SECTION 111226

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SECTION 111226.01 – PACS - SYSTEM DESCRIPTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Description of Parking Access Control system.

- B. Related Sections:

- 1. 111226.00 Parking Access Control System (PACS) for system information and general requirements.
 - 2. 111226.02 Facility Management System for project requirements.
 - 3. 111226.03 Control Gates & Vehicle Detectors for project requirements.
 - 4. 111226.04 Access Control System for project requirements.
 - 5. 111226.07 Intercom System for project requirements.
 - 6. 111226.08 License Plate Recognition (LPR) System for project requirements.

1.3 PROJECT DESCRIPTION

- A. Operational Description:

- 1. The Central Parking Deck will be a 1000 space 5 level precast concrete structure located on Riegel Road at the current surface parking lot 'L'. The deck will accommodate long term parking for residents of the adjacent housing facilities, and daily commuter parking. The ratio of long term to short term parking is about 50/50. On Level 1, the majority of spaces will be made available for visitor parking.
 - 2. There will be three entry/exit locations for the parking deck:
 - a. Southeast Entry/Exit Plaza – These are the main entry and exit lanes for the upper levels of the deck. Vehicles will drive into the entry lane and either have the license plate validated by the LPR camera, or a proximity card validated by the card reader. The gate will open on a valid plate or credential. The exit lane will be free out.
 - b. Southwest Entry/Exit Plaza – These lanes provide entry and exit into the separated visitor parking on Level 1. Vehicles will drive into the entry lane and to have a proximity card validated by the card reader. The LPR camera will be a future installation. The gate will open on a valid credential. The exit lane will be free out.

- c. West Entry/Exit Plaza – There will not be access control equipment at these lanes. PACS equipment for these two lanes is a future installation.

B. Lane and System Configuration:

Southeast Entry/Exit Plaza

1. One (1) entry lane equipped with LPR camera, proximity card reader, automatic gate, intercom, inductive loops, full sign, traffic controller signs at exterior and interior, and other equipment as shown on drawings.
2. One (1) exit lane equipped with automatic gate, intercom, inductive loops, traffic controller signs at exterior and interior, and other equipment as shown on drawings.

Southwest Entry/Exit Plaza

1. One (1) entry lane equipped with proximity card reader, automatic gate, intercom, inductive loops, full sign, traffic controller signs at exterior and interior, and other equipment as shown on drawings.
2. One (1) exit lane equipped with automatic gate, intercom, inductive loops, traffic controller signs at exterior and interior, and other equipment as shown on drawings.

West Entry/Exit Plaza

1. One (1) entry lane equipped with inductive loops for the parking counting system.
2. One (1) exit lane equipped with inductive loops for the parking counting system.

Parking Counting System

1. Parking Counting System installed for counting available spaces per level.

Intercom System

1. Intercom call stations to be installed at all entry lanes and exit lanes. Intercom system to communicate with University's existing system.

Facility Management System

1. Application and database servers, subsystem servers, and all associated communication and control electronics with all associated power conditioning and UPS devices shall be located in the parking management office IT room. All computer equipment shall be modular and rack mounted.
2. Workstations:
 - a. One located in parking management office IT room.

1.4 SYSTEM DESIGN

A. Design-Build Requirements:

1. Equipment and systems described herein shall be designed, fabricated, furnished, and installed by Contractor.
2. Where required, Contractor shall engage licensed professionals to prepare, sign, seal, certify and review designs, documents, reports or any other materials and work required herein.
 - a. Contractor shall review work and submittals of all sub-tier designers, vendors, suppliers, and subcontractors for conformance with the work of this section.

B. Parking Management System includes the following primary systems and components:

1. Parking Access Control System consisting of antennas, transponders, readers, and access credentials.
2. Parking barrier gates for gated control points.
3. Parking Counting System including parking space occupancy sensors, data concentrators, controllers, and dynamic displays.
4. License Plate Recognition System including imaging devices, software, computers with related data storage and appropriate lighting.
5. Facility Management System, including software, computers with related monitors, data communication equipment, data storage devices, and printer.
6. Intercom System including master station, call stations, and related hardware.

C. Vendor to provide all ancillary equipment and support subsystems required for a fully operational facilities management system as described herein.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 111226.01

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SECTION 111226.02 – PACS - FACILITY MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Description of Facility Management System (FMS).

- B. Related Sections:

- 1. 111226.00 Parking Access Control System (PACS) for system information and general requirements.
 - 2. 111226.01 System Description for general information.
 - 3. 111226.03 Control Gates & Vehicle Detectors for project requirements.
 - 4. 111226.04 Access Control System for project requirements.
 - 5. 111226.07 Intercom System for project requirements.
 - 6. 111226.08 License Plate Recognition (LPR) System for project requirements.

1.3 FACILITY MANAGEMENT SYSTEM (FMS):

- A. The system shall be implemented through client server architecture, using personal computers as end-user client workstations and networked system and subsystem servers for application and database functions.
- B. Networked system of servers, task or subsystem computers, workstations, operating system, and application software packages shall provide real-time functionality, on-line monitoring and control of all Parking Management System devices.
- C. Through information generated by system reports, complete FMS shall be capable of:
 - 1. Correlating RCS and ACS entries and exits with vehicles present;
 - 2. Providing independent and consolidated occupancy and activity counts for both RCS, and ACS systems; and
 - 3. Monitoring all lane equipment.
- D. System shall accommodate a minimum of five simultaneous users of the FMS.
- E. FMS shall include redundancy of hardware and software so that failure of any functional component of system shall not result in the loss of data, nor compromise the ability of the system to operate as specified.

- F. FMS servers, task computers, workstations, and all ancillary equipment shall have sufficient power, capacity, and communication bandwidth sufficient to meet the functional performance demands of the PACS software without loss of responsiveness to user input or the slowing of any end node device or workstation.
- G. FMS shall be capable of operating across the Owner's Local Area Networks (LANs) and shall be accessible, with proper user ID and password, to all authorized users' workstations with installed FMS software modules on Owner's LAN. System shall maintain secure connection while active, and automatically log-off after programmable period of inactivity. Remote access to the FMS shall be over standard TCP/IP connection and may use web browser-based applications.
- H. All user-interface modules shall be browser-based utilizing client/server technology or equivalent. The following general requirements apply to all components or modules of the System.
 - 1. The System must have a Windows-based graphical user interface.
 - 2. The System must allow for both standard and custom report formats.
 - 3. The System must have adequate security to allow for different classifications of users.

1.4 LICENSING

- A. Supply all required operating system and application software licenses in sufficient quantities to accommodate the number of users and equipment in the installed system.

1.5 SECURITY

- A. FMS and all subsystem controllers shall have security protocols, password protection, and reports to exception transaction logs that prevent unauthorized access to and manipulation of data and reports, including individual transactions.
- B. All databases of transactions, ACS users, reports, etc shall be secured by means of password from unauthorized entry and tampering from either within or outside FMS.
- C. The System must include minimum of 6 levels of access authorization to all operational, administrative and reporting functions and provide the following security features:
 - 1. Define individual user and group based security
 - 2. Ability to assign a unique user ID for each person authorized to use the system
 - 3. Ability to assign a unique password and periodically change that password for each authorized user ID
 - 4. Ability to establish an expiration period for passwords
 - 5. Ability to disable a user ID following successive log-on failures exceeding a specific limit
 - 6. Ability to view and report user and group level security rights
 - 7. Ability to de-activate codes for former users and internal and external customers
 - 8. Available user-defined fields

PART 2 - PRODUCTS

2.1 CLIENT SERVER SYSTEM FOR FMS:

A. System Configuration:

1. Equipment: contractor shall furnish and install all computer equipment and workstations needed for Facilities Management System. Server architecture shall be of a high-availability (or failover cluster) providing data and operating systems backup and restore. Workstations providing system monitoring and report generation shall be accorded in the following areas:
 - a. Parking Operator's General and Assistant Managers
 - b. Parking Operator's Shift Supervisor
 - c. Parking Operator's Auditors
 - d. Parking Operator's Systems Administrator
 - e. Owner's Finance Department
 - f. Owner's Security Office
2. Performance: equipment shall meet performance needs of software and accommodate for growth and expansion as specified herein. Following are minimum requirements:
 - a. Complete system back up in less than three hours.
 - b. Report generation at a minimum of 35 pages per minute.
 - c. Workstations shall provide the following features:
 - 1) With appropriate password authorization, allow viewing both real-time and historic records of transaction data, generate reports and perform system administrative tasks.
 - 2) Provide system alarms. Alarms shall be selectable at individual workstations with proper password control.
 - 3) Provide ability to print reports at local or network printers as specified.
 - 4) Allow other applications to run concurrently on the workstation.
3. All printers shall be network ready with a minimum print volume of 30 pages per minute.

B. Data Storage:

1. The database portion of the application shall reside and operate on an ANSI SQL-compliant relational database server product.
2. The database shall incorporate integrity controls to enforce the three types of integrity:
 - a. Entity integrity; ensures there are no duplicate keys within a table and all non-null tables are populated.
 - b. Relational integrity; ensures there are no orphan keys, that all transactions properly deleted children entities, and properly modified adult references.
 - c. Domain integrity; ensures that all attribute value ranges are enforced.
3. Transaction records shall be stored as actual data, not in report format. Data shall be archived in a format readable by the report generator.
4. On-line data storage capacity shall be sufficient to store a minimum of 24 months of system data.
5. Archived every six months with the first archive after the first 18 months, so that the server always has the most recent 12 months of data.
6. On-line storage shall be redundant such as RAID Technology.
7. Archive storage shall:

- a. Be on industry standard media i.e. DLTs.
 - b. Be redundant.
 - c. Archive or restore transaction database in less than one hour.
8. FMS shall periodically or on demand download, and send electronically, revenue reports for integration into Owner's financial department via TCP/IP connection to Owner's computer network. Format shall be Microsoft Excel or approved equivalent.

2.2 SOFTWARE AND COMPUTER PERFORMANCE SPECIFICATIONS

- A. All field programmable functions of each device shall be reprogrammed from FMS (password protected), and any and all reprogramming changes shall be reported to daily log.

2.3 FMS SOFTWARE SYSTEMS

- A. FMS shall be configured with software modules for the following subsystems. Each module shall include password protected access to individual functions of each subsystem. Subsystems are:

1. Equipment Monitoring
2. Ad-Hoc Report Generator
3. RCS Software
4. ACS Software
5. LPR
6. Parking Count System

- B. Equipment Monitoring System:

1. FMS shall include system administration module that allows remote monitoring, programming and synchronization of all devices from the Parking Management office.
2. All field programmable functions of each device shall be reprogrammed from FMS (password protected), and any and all reprogramming changes shall be reported to daily log.
3. Equipment monitoring system shall have the following characteristics:

- a. Monitor operational status of all entry and exit lane equipment.
- b. For each entrance lane indicate and display:

- 1) Lane status; open or closed.
- 2) Gate failure.
- 3) Gate up.
- 4) Low-credential supply.
- 5) Credential issued but not taken.
- 6) Illegal exit - reverse direction through lane.
- 7) Backout.

- c. For each exit lane indicate and display:

- 1) Lane status; open or closed.
- 2) Gate failure.
- 3) Gate up.

- 4) Illegal entrance - reverse direction through lane.
 - 5) Backout.
- d. Monitor electrical circuits and frequency of operational error in PACS components to assist operator to identify maintenance actions that would prevent later failure of a component.
- C. Ad-Hoc Report Generator:
1. The System shall include a report generation tool for developing additional standard reports, as well as for developing *ad hoc* reports.
 2. Include ability to automatically print reports based defined event or database trigger.
 3. Provide ability to access database and graphic information summary reports by web browser.
 4. Capability to be exported to common Microsoft Office latest edition products such as Excel and MS Access.
- D. ACS Software: FMS in concert with ACS controller shall provide the following features:
1. Issue and reprogram ID devices.
 2. Provide automatic on-line real-time monitoring of ACS usage.
 3. System shall have capability of monitoring and reporting of ACS alarm conditions to FMS.
 4. System shall have ability to register and utilize compatible foreign ID devices in ACS just as if Owner issued them.
 5. All administrative actions shall be password protected and report to FMS in daily log.
 6. Allow authorized supervisor to create, store, send and receive user programming from ACS readers. Access to programming shall be password protected, with multiple levels of access. System shall have password-protected access to any and all information regarding specific blocks and/or suites of cards.
 7. Provide a data base for ACS management including the following:
 - a. Provide at least 20 programmable record fields on each monthly parker, frequent parker and commercial vehicle tag holder.
 - b. Provide at least 12 programmable record fields on Owner vehicles.
 - c. Allow specific parker record files to be retrieved, displayed and/or printed based on selectable criteria, such as current ACS status, access group, access level, and/or ID numbers (except data that is password protected.)
 - d. Allow searching, sorting and printing of database by any field for routine and special forms such as invoices or mass-mailings.
 - e. Consolidating and retaining data that allow for report generation. The following are minimum required reports. Reports shall be both viewable on a workstation monitor and printed on demand.
 - 1) **Activity Usage Reports** – Provide a chronological list of ACS usage and include date, time, card number, and location of entries and exits. Data shall be capable of being sorted by date, time, card number, and entry/exit lane.
 - 2) **Count Reports** – Monitor and report counts of ACS holders present on hourly basis by group, facility and total occupancy. Track occupancy and report peak occupancy during each hour to FMS. Provide for reports to show daily and/or weekly peak occupancy by access level, group and facility.
 - 3) **Violation/antipassback Report** – Provides a list of ACS customers violating passback settings or nested area time limits.

- 4) **Active User Report** – A listing of all ACS device ID's that have access into or out of facility whether they are owner, courtesy maintenance, or revenue generating. Report shall be sortable in numerical order by, ID number, Suite Number or name and shall include a sum total of all active ID's and can be generated on demand. Report is used to compare revenue generated to authorized users.

E. **Parking Count System:** Subsystem shall provide the following counting functions:

1. Every vehicular entry and exit lane from each area or floor designated as a zone shall serve as a counting location. Each counting location shall be equipped with two vehicle detection loops to provide directional logic at each location and shall transmit counting pulses to FMS. Each entering vehicle shall subtract a count of one from number of available spaces. Each exiting vehicle shall add a count of one to number of available spaces. Directional logic shall be installed so that a vehicle entering an area through an entrance lane or through an exit lane shall be counted as an inbound vehicle. Vehicle exiting an area through an exit lane or through an entrance lane shall be counted as an outbound vehicle.
2. Total number of parking spaces within areas shall be field programmable. Number of available parking spaces within each area shall be tracked and displayed, upon demand, on computer monitor(s). Anti-coincidence packages shall be provided which accurately monitors entering and exiting traffic that may occur simultaneously.
3. Count subsystem shall maintain for each entry and exit lane:
 - a. Non-resettable counters tracking monthly, transient and total parking patron usage.
 - b. Counts of illegal entry/exit for each lane.
 - c. Vends, loops, and gate counts.
4. System shall store lane, facility and zone counts at hourly intervals in daily files. This data shall be available for specialized reports to analyze lot utilization and activity levels.
5. Transaction Counts: count system shall compile, compare and display three separate counts related to each transaction. At entry lanes credential dispenser count shall be compared against directional loop counter and gate counter that records number of gate operations. At exit lanes, compile, compare and display exit controller vend counts, loop counts and gate operation counts.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install and configure FMS on the database and application servers and on all required client workstations.
- B. Provide Owner with a complete list of initial installation administrator user names and passwords for all servers, task computers and workstations.

3.2 TESTING

- A. Provide a server test plan for review and approval by Owner and Engineer/Architect 30 days prior to start of first test. Plan shall include demonstrations of compliance with specifications,

contractual compliance, definitions of all test objectives, participant responsibilities, documentation for tests, and procedures for dealing with failures during test. Provide checklists which detail tests for every functional requirement. Checklist shall provide area for signatory acceptance of Contractor and/or Owner's Representative.

- B. A critical test sequence essential to the completion of the project shall be induced fail-over testing for each of the servers constituting the redundant PACS server cluster. In each sequence of the test, the secondary and/or tertiary servers must provide successful transfer of data from induced failure of the primary operational server.

END OF SECTION 111226.02

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SECTION 111226.03 – PACS - CONTROL GATES & VEHICLE DETECTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Description of Automatic Barrier Gates.
 - 2. Description of Vehicle Detectors.

- B. Related Sections:

- 1. 111226.00 Parking Access Control System (PACS) for system information and general requirements.
 - 2. 111226.01 System Description for general information.
 - 3. 111226.02 Facility Management System for project requirements.
 - 4. 111226.04 Access Control System for project requirements.
 - 5. 111226.07 Intercom System for project requirements.
 - 6. 111226.08 License Plate Recognition (LPR) System for project requirements.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts

- 1. Furnish the following spare components, complete and ready to use, prior to commencement of operational testing and maintain inventory of spare components at this level as components are used during warranty period. After expiration of warranty period, Owner will pay for replacement of parts used from this inventory and not covered by warranty.
 - a. One complete vehicle detector.
 - b. One set of V-belts (if gate is belt driven).
 - c. Two gate arms.
 - d. Two shear bolts/pins.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE SPECIFICATIONS

- A. Provide an effective and automated barrier to vehicles entering or exiting facility.

B. Operational Description for Gated Entry Lanes:

1. As a vehicle pulls into a lane, it is detected by dual loops and a directional vehicle detector. The vehicle is detected by loop A, then by loop B, and then transaction (LPR read or proximity card read) is processed.
2. Upon satisfactory completion of either transaction, gate automatically opens. After vehicle has passed over detector loop C, gate automatically closes.
3. Operating sequence must be completed prior to allowing another vehicle in same lane to commence sequence.

C. Operational Description for Gated Exit Lanes:

1. As a vehicle pulls into a lane, it is detected by dual loops and a directional vehicle detector. The vehicle is detected by loop A and the gate automatically opens.
2. After vehicle has passed over detector loop B, gate automatically closes.
3. Operating sequence must be completed prior to allowing another vehicle in same lane to commence sequence.

D. Distance between end of closed gate and curb or wall is restrictive to motorcycles.

E. Closed gate arm height of approximately three feet unless noted otherwise on drawings.

F. Closed gate arm is firmly parallel to the ground with no sagging.

G. Use articulating gate arms in areas of limited headroom.

H. Employ breakaway design that can be easily replaced when broken away from housing.

I. Provide safety feature of rising upon contact with vehicle or person without causing damage or injury.

J. Incorporate in one housing all necessary components for functioning of unit.

K. Provide circuit breaker protected gate motor and components designed for heavy-duty use.

L. Provide corrosion resistant parts.

M. Provide gate controller that prevents damage when gate motion is blocked in any position and cannot be opened or closed by force applied to gate arm.

N. Allow for adjustment of gate arm travel.

O. Gate Controller features:

1. Microprocessor controlled over-the-network activation and communication for gate status and functions from FMS.
2. Separate momentary contact closures for each of the following counts:
 - a. ACS patrons
 - b. Vehicle entries
 - c. Vehicle exits

3. Directional logic with electronic outputs to alarms, counters and to report atypical lane activity to FMS.
4. Ability to test gate operability and controller programming on-site without use of special diagnostic equipment.
5. "AUTO-MANUAL" switch, and "ON-OFF" switch for gate.
6. Contains power supplies, dust-proof relays, and other circuit components to control gate.
7. Provide remote gate arm activation (with sufficient line of sight or CCTV camera coverage).

P. Control Gate Usage Restrictions:

1. Provide signage prohibiting pedestrians and motorcycles from utilizing control gate as a means of ingress or egress to facility.
2. Provide along approach route of automated gate and/or affixed to both sides of control gate arm.
3. Incorporate both text and graphics to convey hazards of not meeting this restriction.

2.2 VEHICLE DETECTION

- A. Incorporate/employ anti-tailgating logic, vehicle inductive profiling, and self-tuning technology.
- B. Maintain peak sensitivity regardless of temperature, rain or other environmental conditions.
- C. Fit within entry and exit controllers, or gate housings, or in remote lane/ramp controller cabinet.
- D. Provide indicator light on front panel indicating presence of vehicle.
- E. Require no special tools or meters for adjustment following initial installation
- F. If tied to inductive loops, provide multiple loop tuning to prevent crosstalk or interference between loops in close proximity of each other.
- G. Provide directional logic using "A-B" logic as follows:
1. Sensor "A" activates lane device for ACS operation.
 2. Following ACS operation, gate opens.
 3. Vehicle passes Sensor "B", sending signal to close gate. Count increases by one.
 4. Sequence of Sensor provides directional logic.
 5. Activation of Sensor "A" without Sensor activation at "B" results in an incomplete transaction.
- H. If using Inductive Loops as sensing device:
1. Cut-into paving surface and filled with manufacturer's approved sealant (see drawings).
 2. Be formed by three to four turns of 16-gauge XLPE single-conductor wire.
 3. No splices are permitted.
 4. Contain loop leads:
 - a. Limited to a length of 100 feet.
 - b. Have a four-twist minimum per foot and located at a minimum of 18 inches from electrical power lines.
 - c. Be contained in separate conduit to prevent interference from electrical signals.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install parking control equipment as required for a complete and integrated installation.
 - 1. Rough-in electrical connections according to requirements specified in Division 26 Sections.
- B. Automatic Barrier Gates: Anchor cabinets to concrete bases with anchor bolts or expansion anchors and mount barrier gate arms.
 - 1. Install barrier gates according to UL 325.
- C. Vehicle Loop Detectors: Cut grooves in pavement and bury and seal wire loop at locations indicated on Drawings according to manufacturer's written instructions. Connect to parking control equipment operated by detector.
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.2 ADJUSTING

- A. Adjust parking control equipment to function smoothly and lubricate as recommended by manufacturer.
- B. Confirm that locks engage accurately and securely without forcing or binding.
- C. After completing installation of exposed, factory-finished parking control equipment, inspect exposed finishes and repair damaged finishes.

3.3 PROTECTION

- A. Remove barrier gate arms during the construction period to prevent damage. Install them immediately before Substantial Completion.

END OF SECTION 111226.03

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SECTION 111226.04 – PACS - ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Description of Access Control System (ACS).

- B. Related Sections:

- 1. 111226.00 Parking Access Control System (PACS) for system information and general requirements.
 - 2. 111226.01 System Description for general information.
 - 3. 111226.02 Facility Management System for project requirements.
 - 4. 111226.03 Control Gates & Vehicle Detectors for project requirements.
 - 5. 111226.07 Intercom System for project requirements.
 - 6. 111226.08 License Plate Recognition (LPR) System for project requirements.

1.3 ACS SYSTEM DESCRIPTION:

- A. ACS shall be an on-line, computer-based system for those authorized by Owner to have access to controlled parking areas without being processed through RCS. Distributive, networked, or centralized processing may be employed, so long as required multi-lane control features such as anti-passback, occupancy, and activity tracking are maintained. System shall employ Proximity Card Technology and License Plate Identification (LPR) as specified herein. System shall control access for the following types of user groups:
 - 1. Owner vehicles requiring free and fast ingress/egress to parking facility.
 - 2. Resident parkers who prearrange for parking and have unrestricted entry and exit privileges.
 - 3. Commuter parkers who prearrange for parking and have unrestricted entry and exit privileges.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE SPECIFICATIONS

- A. Operational Parameters:

1. ACS reader identifies that a vehicle with a credential has entered lane and receives coded information from the credential. Validity of credential for current authorization in this system shall be checked through ACS controller and, if approved, system shall issue a gate vend to open gate while recording transaction data in ACS database.
2. Where ACS lanes are also equipped with transient credential dispensers at entrances or acceptors at exit lanes, activation of reader shall automatically disable dispenser/acceptor. Initiation of a transient credential entry/exit transaction shall automatically disable ACS reader in that lane.
3. If ACS credential is not valid for system or is not authorized for entry at that location and/or at that time, ACS controller shall send an invalid user attempt message to FMS. Gate shall not open. An invalid ACS attempt alarm shall initiate an audible alarm and display a message at FMS workstations. Invalid user ACS attempt shall also be posted to daily exception transaction log.

B. ACS system shall have the following features:

1. Individually recognize and process at least **<5,000>** ACS users at up to **<10>** reader locations.
2. Have at least 16 preprogrammed access levels. Access level of credential shall be capable of being changed without reprogramming of ACS. User capacity shall not be lost due to changes to ACS programming and access levels.
3. Provide anti-passback control. With this feature, users shall enter and exit in proper sequence (i.e., entry, exit, entry, exit). System shall be selectable to allow either "hard" (out of sequence user is rejected and an alarm is generated at ACS controller and FMS) or "soft" mode (out-of-sequence user is allowed access with notice recorded at FMS.) Access shall be programmable as soft or hard per user. In both hard and soft modes, each out-of-sequence event is reported as an exception transaction in daily ACS access log. Timed anti-passback (in which credential cannot be used out-of-sequence until programmable time period has elapsed from last ACS use) is not acceptable. A password-protected "resynchronization" of all users to one access before return to anti-passback control shall be provided.

C. Proximity Card System:

1. Credential Design and Reader Requirements:
 - a. Credential shall be of passive design and capable of being read when presented within 6 inches of sensor.
 - b. Accuracy of card read shall be 99.5%.
 - c. ACS shall read and process credential within one second of presentation to reader. Card/gate system shall be able to maintain processing rate of 500 transactions per hour for period of at least four continuous hours of operation, including normal patron delays.
 - d. System shall have checking protocol that identifies multiple reads of same card within a few seconds (due to users "waving" the card in front of reader) and corrects false anti-passback reads.
 - e. System shall include protection from common and/or local sources of interference. System shall neither affect nor be affected by neighboring electronic systems or electronically controlled devices.

2.2 STOCK ITEMS

- A. Stock: Furnish the following operating stock items prior to commencement of operational testing. Contractor shall provide samples for Owner approval prior to final order of any item that is custom printed. Manufacturer shall select actual size of credential devices. Owner must approve color and artwork of credential devices. Owner will provide camera-ready artwork for logos if appropriate.

1. #,### Proximity Card Credentials

PART 3 - EXECUTION

3.1 VERIFICATION TESTS

- A. Proximity Card System

1. Normal Transaction

- a. Have vehicle approach exit station and activate vehicle detection loop.
- b. Wave credential within six inches of reader.
- c. Confirm that credential is accepted and gate rises for passage.
- d. Confirm that credential use data is logged to database.

2. Pass-back Test (Requires two vehicles)

- a. Have vehicle approach exit station and activate vehicle detection loop.
- b. Wave credential within several inches of reader.
- c. Confirm that credential is accepted and gate rises.
- d. Have patron pass credential to next vehicle in queue.
- e. Have Vehicle #1 pass through gate.
- f. Have Vehicle #2 approach and try use same credential.
- g. Confirm Vehicle #2 is denied passage.
- h. Confirm that Pass-back alarm is activated on FMS
- i. Confirm that Pass-back data is logged to database.

3. Invalid Transaction

- a. Have vehicle approach exit station and activate vehicle detection loop.
- b. Wave system invalidated credential within several inches of reader.
- c. Confirm that credential is NOT accepted and gate does NOT rise.
- d. Confirm that attempted use of credential is logged to database.

4. Intercom Station

- a. Verify intercom activates when button is depressed.

END OF SECTION 111226.04

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SECTION 111226.07 – PACS - INTERCOM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Description of Intercom System.

- B. Related Sections:

- 1. 111226.00 Parking Access Control System (PACS) for system information and general requirements.
 - 2. 111226.01 System Description for general information.
 - 3. 111226.02 Facility Management System for project requirements.
 - 4. 111226.03 Control Gates & Vehicle Detectors for project requirements.
 - 5. 111226.04 Access Control System for project requirements.
 - 6. 111226.08 License Plate Recognition (LPR) System for project requirements.

1.3 INTERCOM SYSTEM DESCRIPTION

- A. The System shall be compatible with the University's existing Intercom System.
- B. System shall provide voice communication capability in "simplex", "duplex" or "full duplex" mode selectable for each substation separately. The system shall also provide group call, all call features and pre-programmable conferences and flexible conferences with an unlimited number of substations in each conference.
- C. The System shall be microprocessor controlled, shall incorporate modular components and shall be designed for ease of use, maintenance, and diagnostic testing.
- D. The system shall utilize digital signal processor (DSP) technology for master stations and substations. It shall be possible to upgrade DSP system features by uploading a software upgrade without the need for hardware modifications. Substations shall be upgradeable from any location within a networked system. It shall not be necessary to replace firmware chips to upgrade system.
- E. Line supervision of each station shall be possible and line failure shall be reported to predefined stations. Microphone/speaker supervision shall monitor station operation and shall immediately report any failure to system master station. Testing interval shall be programmable.

- F. The architecture of the Intercom System shall support digital networking of several locations by means of fiber optic, LAN/WAN/Ethernet, 2-wire HDSL, GSM, or other digital transmission systems.
- G. The digital networking shall provide at least 10 speech channels between sub-master stations and shall also support remote programming to any sub-master from master station.
- H. Ethernet/LAN/WAN networking shall be accomplished with a plug-in networking card for direct access to a 10baseT Ethernet connection without the need of an external modem/interface. No additional programming device or software for configuration shall be required.
- I. The system shall be expandable to minimum of 100 substations.
- J. Intercom master panel shall include one auxiliary external audio input and shall provide minimum of 10 group conference channels.

PART 2 - PRODUCTS

2.1 INTERCOM SERVER

- A. Intercom server shall be fully digital, microprocessor based, modular design. Programming server for all intercom features shall be performed through networked workstation or from intercom master station. Programmed configuration of intercom stations and system features shall be stored in non-volatile memory. System shall include all software required for programming the system.
- B. Volume control shall be programmable individually for each intercom station. Volume shall be user adjustable at staffed cashier stations.
- C. Substations shall be programmed to call intercom master station. System shall include call forwarding feature for individual stations or all stations to re-direct calls to another designated master station or substation.
- D. The system shall allow conferencing for an unlimited number of stations from master station.
- E. The system shall include ability to announce up to 50 pre-recorded messages at intercom stations. Announced message shall be selectable based on programmed criteria, or from input from entry controllers, exit controllers, automated paystations, or from cashier stations. Provide audio input to allow music or other audio signals to be distributed to any or all programmed stations. Announced messages and audio input broadcasts shall be interrupted only at affected intercom station during intercom calls and return automatically upon completion of the call.
- F. If master station is busy, system shall automatically announce pre-recorded message at calling station, when the master station disconnects, another pre-recorded message shall direct station to re-initiate call.

2.2 MASTER STATIONS

- A. Master stations shall be desktop model with LCD-Display (8 lines x 14 characters minimum) and gooseneck noise cancelling microphone designed for high-noise environment.
- B. Station shall provide full-duplex hands-free conversation with any other selected individual station or combination of stations in system.
- C. Station shall include an integrated amplifier and loudspeaker. Master station shall also include connector and external noise cancelling headset.
- D. Firmware/feature upgrades shall be made available via download through the intercom server. No local modification on the station shall be required.
- E. Station shall incorporate high sensitive microphone to provide clear conversation from a maximum range of at least 20 ft.
- F. The minimum audio frequency range for audio components shall be 200-7000Hz.
- G. Provide intercom station directory panel with direct access, pre-programmable function menus, selectable language, and adjustable display contrast.
- H. Stations shall include a "handset function" enabling user to switch from loudspeaking, gooseneck microphone operation to handset mode.

2.3 SUBSTATIONS

- A. Each Intercom station shall be equipped with microphone, loudspeaker and in-use LED, all housed in one unit with configurable front pushbutton control.
- B. Cashier stations shall include: duplex-controller, volume control and microphone sensitivity adjustment and jacks for external loudspeaker, headset, and microphone.
- C. Substations at cashier stations shall be desktop units and all other stations shall be flush mounted within parking management system equipment.
- D. Station shall utilize DSP technology to provide full speaker/microphone supervision and fully adjustable (volume/timing threshold programmable via intercom server) audio monitoring. Feature upgrade shall be made available via download through the intercom server. No local modification shall be required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all intercom equipment and communication cabling in accordance with manufacturer's recommendations.
- B. Coordinate intercom station with ACS subsystem equipment. Provide other vendors with intercom station mounting templates, power and communication wiring requirements and any other information required to integrate intercom stations into ACS equipment cabinets.

- C. Intercoms shall be designed to withstand severe weather conditions and comply with ergonomic standards required by ADAAG. Whenever possible, the intercom call button and speaker grill shall be integrated into the primary PACS equipment face-plate for each respective lane or payment machine location. Any separate support stanchion for the intercom unit itself is to be avoided unless the intercom system is the primary PACS equipment controller for a lane.

END OF SECTION 111226.07

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SECTION 111226.08 – PACS - LICENSE PLATE RECOGNITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Description of License Plate Recognition (LPR) system.

- B. Related Sections:

- 1. 111226.00 Parking Access Control System (PACS) for system information and general requirements.
 - 2. 111226.01 System Description for general information.
 - 3. 111226.02 Facility Management System for project requirements.
 - 4. 111226.03 Control Gates & Vehicle Detectors for project requirements.
 - 5. 111226.04 Access Control System for project requirements.
 - 6. 111226.07 Intercom System for project requirements.

1.3 LICENSE PLATE RECOGNITION (LPR):

- A. License Plate Recognition system (LPR): LPR system shall be an on-line system with LPR check on every ACS transaction.
- B. Imaging devices at the entry lane where noted shall automatically gather LPR data using character recognition to extract license plate number from images.
- C. The image of the license plate and/or rear of the vehicle shall be linked to the ACS transaction and stored in the computer database.
- D. System shall correlate license plate number with transient credential dispensed or ACS ID device used at entry lane.
 - 1. At entry lane, imager and system shall extract license plate number and compare with plate number associated with FMS database.
 - 2. If license number comparison is positive, ACS shall complete transaction and raise the gate.
- E. LPR subsystem shall include imaging devices with appropriate lighting, software, application and database servers, workstations, and report printers.

1.4 LICENSING

- A. Supply all required operating system and application software licenses in sufficient quantities to accommodate the number of users and equipment in the installed system.

1.5 SECURITY

- A. Provide security features compatible with the University's existing FMS system.

PART 2 - PRODUCTS

2.1 LPR SYSTEM

- A. The LPR system shall read four of seven digits on license plates with 98% accuracy. When there is not a match, the picture of the plate and back of vehicle shall be displayed on a workstation (supervisor intervention) so a manual match can be chosen.
- B. License Plate Inventory Software: Subsystem shall provide the following features:
 - 1. LPI system shall be provided for in the lane designated in the contract documents. Combined summary of LPI inventory of all facilities is also required at FMS.
 - 2. Provide back-up solution with software and sufficient capacity to automatically back-up current inventory from computer and store for one year.
 - 3. Provide reports printed and via monitor at FMS and workstations programmable on demand or automatically generated.
 - 4. Reports shall include summary totals of number of cars parked.
 - 5. Report listing shall be alphanumeric by state and license plate number.
 - 6. Software shall allow, with password control, manual entry and editing of records via computer keyboard.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install and configure LPR on the database and application servers and on all required client workstations.
- B. Provide Owner with a complete list of initial installation administrator user names and passwords for all servers, task computers, and workstations.

3.2 TESTING

- A. Provide on-site testing of LPR demonstrating the system's ability to read and store the license plate information with a minimum 98% read accuracy at all lanes.
- B. Produce a sample of the required reports during test phase.

END OF SECTION 111226.08

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SECTION 142105 - ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK AND REFERENCES

- A. This Section covers and includes the furnishing and installing of passenger elevator equipment as hereinafter described.
- B. All terms of this specification shall have their meaning defined in the American Society of Mechanical Engineers A17.1 Safety Code for Elevators and Escalators and hereinafter referred to as ANSI A17.1 Code, including all revisions and authorized changes to date.
- C. All work shall be performed in a first-quality manner and is to include all work and material in accordance with the drawings and as specified herein.
- D. In all cases where a device or part of the equipment is herein referred to as a single component, it is intended that such reference shall apply to as many such devices as are required to complete the installation.
- E. All work shall be performed in accordance with the latest revised edition of the American Society of Mechanical Engineers ASME/ANSI A17.1 Safety Code for Elevators and Escalators, the National Electrical Code and N. C. State Building Code(s) and other required codes that are applicable. Additional payments or changes in the contract work by the contractor are to be accomplished by a properly executed change order. This process must be in accordance with the North Carolina Construction Manual.

1.2 RELATED WORK BY OTHERS

- A. General contractor shall provide the following in accordance with the requirements of the ANSI A17.1 Code, NC State Building Codes, NFPA 70 National Electrical Code and other required codes.
 - 1. A properly framed clear, plumb hoistway with variations not to exceed $\frac{1}{2}$ " at any point, including adequate guards and protection of hoistway during the erection period.
 - 2. Access to the machine room and machinery space as required by the ANSI A17.1 Code and NC State Building Code.
 - 3. Legal size machine room with ventilation and temperature to be maintained between 65° - 90° F. Consult elevator contractor to verify this temperature range.
 - 4. Projections, recesses and setbacks in hoistway enclosures exceeding 4" shall be beveled at an angle not less than 75° with the horizontal.
 - 5. Supports for rail brackets at pit, each floor and roof. Maximum allowable vertical spacing of rail supports, without backing. Divider beams between hoistway at each floor and roof, for guide rail bracket support.
 - 6. Light and convenience outlets (GFCI) in machine room with light switches located within 18 inches of lock jamb side of machine room door.
 - 7. A fused disconnect for the main power supply conductors for each elevator as per the NFPA 70, NEC, Article 620-51.

8. A separate branch circuit with fused disconnect switch in the machine room for each elevator car lighting power source.
9. A separate branch circuit for elevator signal circuit, when required by the elevator control system.
10. Convenience outlet (GFCI) and a minimum of two light fixtures per elevator located in elevator pit. Locate pit light switch adjacent to the pit access ladder(s) 48 inches above the lowest landing hoistway entrance sill.
11. Provide a vertical iron ladder for access to each elevator pit. Extend pit ladder a minimum of 48 inches above the lowest landing hoistway entrance sill. Consult elevator contractor for location.
12. Provide ventilation of the hoistway as required by the NC State Building Code.
13. Recesses, supports and patching, as required to accommodate hall button boxes, signal fixtures, oil lines, etc.
14. Provide a dry waterproof pit reinforced to sustain vertical forces on car rails and impact loads from car buffers and cylinder head.
15. Front entrance partition walls to be constructed after door frames and sills are set in place. If entrance walls are poured concrete bearing walls, rough openings are to be provided to accept entrance frames and filled in after frames are set.
16. Level surface of finish floor at each landing to be continuous for full width of hoistway. Adequate support or sill angle across full width of hoistway at each landing. Vertical surface of entrance sill support to be plumb, one above the other, and square with the hoistway. Grout, if required, between door frames to sill line to provide a smooth level surface.
17. Any cutting, patching and painting of walls, floors or partitions.
18. Electric power for lights, tools, hoist, etc., during erection as well as required power for installing, testing and adjustment of the elevator.
19. Fire recall initiating devices (smoke, heat, etc.) or products of combustion sensing devices connected to elevator machine room controller terminals. Provide fire alarm panel as required.
20. Requirements for elevators, if emergency power is provided, as per the ANSI A17.1 Code and NC State Building Code.
21. Telephone line wiring routed to elevator controller for each elevator cab.
22. Proper trenching and backfilling for any underground piping or conduit.
23. Class "ABC" fire extinguishers provided in electrical machinery and control spaces. Locate convenient to the access door.
24. Pit drain or sump pump for elevator pits. Cover shall be secure and level with pit floor.
25. Cutout through machine room wall for oil line, etc. Coordinate location and size with elevator contractor.

1.3 QUALITY ASSURANCE

- A. In the interest of unified responsibility, the elevator contractors shall be one regularly engaged in the business of installing and servicing of the type and character required by these specifications.
 - 1. The contractor shall have technical qualifications of at least five years experience, trained supervisory and installation personnel, and facilities to install specified items.
 - 2. Any manufacturer's product submitted shall have been in satisfactory and efficient operation on not less than twenty-five installations similar to this project and for not less than one and one-half years. Contractor shall submit a list of installations, including names and addresses to the Designer for approval, as per the North Carolina Construction Manual, General Conditions of the Contract, Article 16.
 - 3. There shall be a permanent service organization maintained or trained by contractor which will render satisfactory service to this installation within two hours of receipt of notification that service is needed. Submit name and address of service organization.
 - 4. All designs, clearances, construction, workmanship and material shall be in accordance with the ANSI A17.1 Code, NC State Building Codes, NFPA 70 National Electrical Code and all codes having legal jurisdiction.
- B. The major elevator components shall be the products of one manufacturer of established reputation, except they may be the products, either wholly or in part, of another manufacturer of established reputation provided such items are engineered and produced under coordinated specifications. Any contractor who proposes to install any major elevator component not manufactured or normally assembled by him, as part of his equipment, shall have such product approved by the North Carolina Department of Labor, Elevator Bureau, prior to bidding this specification. Also, the major components to be furnished shall be of a make or makes that have performed satisfactorily together under conditions of normal use in not less than twenty-five other elevator installations of equal or greater capacity and speed for a minimum of one and one-half years within the United States, and a minimum of three installations in North Carolina. Upon request the names and addresses of the building and the names of the owners or managers thereof, in which the proposed combination of major components has so performed, shall be furnished.
 - 1. The term major elevator components as mentioned above shall mean such items as a machine, controller, door operator and related equipment.

1.4 SUBMITTALS

- A. The elevator contractor shall, after structural and architectural drawings are furnished, submit complete working drawings, showing the location of all equipment, loads, and all other information necessary to render a totally functional elevator.
- B. The elevator contractor shall provide finish samples upon request, and cab entrance and fixture cutsheets.
- C. The elevator contractor shall provide two complete sets of electrical and solid state wiring diagrams, operating and maintenance manuals. These shall include:
 - 1. Description of the elevator system's sequence of operation and control including the functions of signals, door devices and other features;
 - 2. Written instructions for the trouble-shooting, adjustment and care of the entire equipment;

3. Electrical prints shall be reproducible type, non-fading;
4. One set shall be sealed in a clear material and mounted in the elevator machine room;
5. All electrical wiring diagrams shall be as built drawings. If standard drawings are used they shall be marked up according to the installation for which they apply;
6. The identification label for each diagram and manual shall include the subject, building name, location, contract number, and the specified state assigned elevator number to which the diagrams and manuals apply;
7. One set of diagrams and manuals shall be delivered to the Designer who will deliver them to the engineering officer of the facility; and
8. The elevator contractor shall notify the North Carolina Department of Labor for scheduling of a final inspection as per code and specifications. Approval must be given that all code requirements have been met and that installation complies with the specifications before final payment will be made.
9. Tools, programmers, laptops, etc. necessary to maintain and/or trouble-shoot the elevator system shall be furnished to the owner. Provide instructions manuals, etc., in the operation of these special tools.

1.5 TEMPORARY USE

- A. Should the service of an elevator be required before completion and final acceptance, permission in writing must first be obtained for the Designer. In addition, the user shall sign the elevator contractors temporary acceptance form and be bound by the terms and conditions.

1.6 DELIVERY, STORAGE AND HANDLING

- A. A dry and protected area, conveniently located to the elevator hoistway will be assigned to the elevator contractor without cost for storage of his materials and tools.
- B. Should the building or site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor shall provide a proper and suitable storage area on or off the premises.

1.7 WARRANTY

- A. The elevator contractor shall guarantee the materials and workmanship against defect due to faulty materials or faulty workmanship or negligence for a period of twelve (12) months from the date of Final Acceptance. Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material from the date of Final Acceptance. The contractor shall replace such defective materials, equipment, or workmanship without cost to the owner within the stipulated guarantee period.
- B. This warranty is not intended to supplement normal maintenance service and shall not be construed to mean the elevator contractor will provide free service for periodic examination, lubrication, or adjustment due to normal use, beyond that included in the specifications; nor will the elevator contractor correct, without charge, breakage maladjustments or other trouble arising from abuse, misuses, or improper use of the equipment, which may develop within twelve (12) months from the date of Final Acceptance.

1.8 MAINTENANCE

- A. Maintenance Service: The elevator contractor shall furnish an all-inclusive first-quality maintenance and call-back service on each elevator after it is completed and placed in operation for a period of twelve (12) months, concurrent with warranty period. This service shall consist of examinations of the equipment at a minimum of once a month. Service shall include adjustments, lubrication, cleaning, supplies and parts to keep the equipment in proper operation, except for such adjustments, replacement of parts or repairs made necessary by abuse, misuse or any other causes beyond the control of the elevator contractor. All work will be done by trained employees of the elevator contractor during regular working hours of the trade. Emergency call-back service shall be provided at no cost to the owner and included for all hours and days during the maintenance period.
1. Thirty days before expiration of the twelve (12) month maintenance service, the elevator contractor shall schedule an inspection of the elevator equipment with the Owner or his representative. This inspection is to assure that the elevator equipment is in safe first-quality, operating condition and the equipment is operating in line with its original design. An authorized representative of the elevator contractor shall accompany the Owner or his representative.
- B. Examinations and Log: During the warranty maintenance period the elevator contractor shall maintain maintenance records as per ANSI A17.1 Code for each elevator. The records shall be located in the elevator machine room and be used to indicate all call backs, repairs, replacement of parts, fire service test and adjustments performed by the mechanic. Each entry in the maintenance records shall be signed by the mechanic who performs the work and be kept up-to-date at all times.
- C. The periodic lubrication of elevator components shall not be required, including: Sheaves, Rails, Belts, Ropes, Car and CWT guides, etc.
- D. The elevator control system must:
1. Provide in the controller the necessary devices to run the elevator in inspection operation.
 2. Provide on top of the car the necessary devices to run the elevator in inspection operation.
 3. Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
 4. Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
 5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
 6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.

1.9 PAINTING - EQUIPMENT/FLOORS

- A. All exposed metal work and equipment furnished by the elevator contractor under these specifications shall be properly painted after installation in order to present a new appearance, as otherwise specified.
1. Minimum requirements shall include one coat of metal primer, and one coat of semi-gloss industrial grade enamel.

2. All surfaces painted must be clean before painting.
3. Machine room floors and pit floors shall be cleaned and painted with two coats of semi-gloss industrial grade enamel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Otis Elevator Co.; Product Gen2: www.otis.com.
- B. Other Acceptable Manufacturers:
 1. ThyssenKrupp Elevator: www.thyssenkruppelevator.com.
 2. Schindler Elevator Corp: www.us.schindler.com.
- C. All components to be manufactured by same entity, unless otherwise indicated.

2.2 SYSTEM DESCRIPTION (ELEVATORS 1 & 2)

- A. Equipment Description: Gen2 gearless traction elevator with Machine-Roomless application.
 1. Equipment Control: Elevonic Control System.
 2. Drive: Regenerative
 3. Quantity of Elevators: Two (2)
 4. Stops: Four (4)
 5. Openings: 4 at Front, 0 at Rear.
 6. Travel: As indicated.
 7. Rated Capacity: 3500 lbs.
 8. Rated Speed: 150 FPM
 9. Clear Inside Dimensions: 6' 5-9/16" wide x 5' 5-9/16" deep
 10. Cab Height: 9'-7"
 11. Clear Cab Height: 8'-11-3/4" under suspended ceiling
 12. Entrance Type and Width: Left Opening; 3'-6"
 13. Entrance Height: 8'-0"
 14. Main Power Supply: 208 Volts + or - 5% of normal, three-Phase, with a separate equipment grounding conductor. Transformer (by others) required for voltages other than 440, 460 or 480 volts.
 15. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.
 16. Machine Location: Inside the hoistway at the top of the hoistway.
 17. Signal Fixtures: Manufacturer's standard with metal button targets.

18. Controller Location: Machine-Roomless Controller(s) shall be located at the front opening of the top terminal landing in entrance frame.
- B. Performance:
1. Car Speed: + 3 % of contract speed under any loading condition or direction of travel.
 2. Car Capacity: Safely lower, stop and hold up to 120% of rated load. (code required).
- C. Ride Quality:
1. Vertical Vibration (maximum): 12 milli-g
 2. Horizontal Vibration (maximum): 12 milli-g
 3. Vertical Jerk (maximum): $4.59 \pm 1.0 \text{ ft./ sec}^3$ ($1.4 \pm 0.3 \text{ m/ sec}^3$)
 4. Acceleration/Deceleration (maximum): 2.62 ft./ sec^2 (0.8 m/ sec^2)
 5. In Car Noise: 55 - 60 dB(A)
 6. Stopping Accuracy: $\pm 0.5 \text{ in.}$ ($\pm 12 \text{ mm}$) max, $\pm 0.25 \text{ in.}$ ($\pm 6 \text{ mm}$) Typical
 7. Re-leveling Distance: $\pm 0.5 \text{ in.}$ ($\pm 12 \text{ mm}$)
- D. Operation: Simplex Collective Operation- Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
- E. Operating Features
1. Full Collective Operation
 2. Anti-nuisance.
 3. Fan and Light Protection.
 4. Load Weighing Bypass.
 5. Independent Service.
 6. Full Collective Operation.
 7. Firefighters' Service Phase I and Phase II
 8. Top of Car Inspection
 9. Zoned Access at Bottom Landing.
 10. Zoned Access at Upper Landing
 11. Automatic Rescue Operation (Battery Powered Lowering Device)
- F. Door Control Features:
1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
 2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.

3. Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening. Under normal operation and for any door position, the system shall detect as a blockage an opaque object that is equal to or greater than 1.3 inches (33 mm) in diameter when inserted between the car doors at vertical positions from within 1 inch (25 mm) above the sill to 71 inches (1800 mm) above the sill. Under degraded conditions (one or more blocked or failed beams), the primary protection shall detect opaque objects that are equal to or greater than 4" (100 mm) in diameter for the same vertical coverage. If the system performance is degraded to the point that the 4" object cannot be detected, the system shall maintain the doors open or permit closing only under nudging force conditions.
4. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

G. Provide equipment according to seismic zone: Zone 0/1

2.3 DESIGN AND SPECIFICATIONS

- A. Provide machine-roomless Gen2 traction passenger elevators from Otis Elevator Company. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:
 1. An AC gearless machine using embedded permanent magnets mounted at the top of the hoistway.
 2. Polyurethane Coated-Steel Belts (CSB's) for elevator hoisting purposes.
- B. Approved Installer: Otis Elevator

2.4 EQUIPMENT: CONTROLLER COMPONENTS

- A. Controller: A microcomputer based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.
 1. All high voltage (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open.
 2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.
 3. Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC)
 4. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 - immunity"
- B. Drive: A Variable Voltage Variable Frequency AC drive system shall be provided. The drive shall be set up for regeneration of AC power back to the building grid.

2.5 EQUIPMENT: MACHINE AND GOVERNOR

- A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.
- B. Governor: The governor shall be a tension type car-mounted governor.
- C. Buffers, Car and Counterweight: Polyurethane type buffers shall be used.
- D. Hoistway Operating Devices:
 - 1. Emergency stop switch in the pit
 - 2. Terminal stopping switches.
- E. Positioning System: Consists of an encoder, reader box, and door zone vanes.
- F. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.
- G. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords.
- H. Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core center.
- I. Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.
- J. Hoistway Entrances:
 - 1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
 - 2. Sills shall be Extruded Aluminum.
 - 3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
 - 4. Fire Rating: Entrance and doors shall be UL fire rated.
 - 5. Entrance Finish: Satin Stainless Steel #4 finish at each landing.
 - 6. Entrance marking plates: Entrance jambs shall be marked with 4" x 4" plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
 - 7. Sight Guards: Black sight guards will be furnished with all doors.

2.6 EQUIPMENT: CAR COMPONENTS

- A. Carframe and Safety: A carframe fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the carframe and shall be Type "B", flexible guide clamp type.
- B. Cab: Satin Stainless Steel #4; floor finish by others.
- C. Car Front Finish: Satin Stainless Steel #4

- D. Car Door Finish: Satin Stainless Steel #4
- E. Dropped flat steel ceiling, satin stainless steel finish with 4 LED lights.
- F. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.
- G. Fan: A one-speed 120 VAC fan will be mounted to the structural ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.
- H. Handrail: Handrails shall be 3/8" x 2 inch flat handrail with a brushed steel finish. Handrails shall be provided on the side and rear of the car enclosure.
- I. Threshold: Extruded Aluminum
- J. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
- K. Guides: The car and counterweight shall have slide type guides at the top and the bottom.
- L. Platform: The car platform shall be constructed of metal. Load weighing device shall be mounted on the belts at the top of the hoistway.
- M. Certificate frame: Provide a Certificate frame with a satin stainless steel finish.

2.7 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

- A. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel finish.
 - 1. Standard car operating panel shall be furnished. It shall contain a bank of round metal (plastic when required by some local California codes) mechanical illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings. Blue LED halo illumination with 1/8" Projecting targets. Target finish is satin stainless steel.
 - 2. The car operating panel shall be equipped with the following features:
 - 3. Standard:
 - a. Raised markings and Braille to the left hand side of each push-button.
 - b. Car Position Indicator at the top of and integral to the car operating panel.
 - c. Door open and door close buttons.
 - d. Inspection key-switch.
 - e. Elevator Data Plate marked with elevator capacity and car number.
 - f. In car stop keyswitch key
 - g. Firefighter's hat
 - h. Firefighter's Phase II Key-switch

- i. Call Cancel Button
 - j. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
 - k. Firefighter's Phase II Emergency In-Car Operating Instructions: worded according to A17.1 2000, Article 2.27.7.2.
 - l. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
- B. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.
- C. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Hall fixtures shall have a satin stainless steel finish.
- 1. Standard Integral Hall fixtures shall feature round mechanical buttons marked to correspond to the landings, in the entrance frame face. Buttons shall be 1/8" Projecting in vertically mounted fixture. Hall Position indicators shall be illuminated by means of LED. Fixture shall be satin stainless steel finish. All button targets shall be metal except state of CA, they shall be lighted.
- D. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine hoistways, hoistway openings, and pits before starting elevator installation.
- B. Verify hoistway, pit, overhead, and openings are of correct size, within tolerances, and are ready for work of this section.
- C. Verify walls are plumb where openings occur and ready for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.
- D. Verify hoistway is clear and plumb, with variations not to exceed -0 to +1 inch at any point. Verify projections greater than 4" must be beveled not less than 75 degrees from horizontal. No negative tolerance is permitted for minimum hoistway dimensions.
- E. Verify minimum 2-hour fire-resistance rating of hatch walls.
- F. Notify Architect in writing of dimensional discrepancies or other conditions detrimental to proper installation or performance of elevators.
- G. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to manufacturer/installer.

3.2 INSTALLATION

- A. Install equipment, guides, controls, car and accessories in accordance with manufacturer installation methods and recommended practices.
- B. Properly locate guide rails and related supports at locations in accordance with manufacturer's recommendations and approved shop drawings. Anchor to building structure using isolation system to minimize transmission of vibration to structure.
- C. All hoistway frames shall be securely fastened to fixing angles mounted in the hoistway. Coordinate installation of sills and frames with other trades.
- D. Lubricate operating system components in accordance with manufacturer recommendations.
- E. Perform final adjustments, and necessary service prior to substantial completion.

3.3 CONSTRUCTION

- A. Interface with Other Work:
 - 1. Guide rail brackets attached to steel shall be installed prior to application of fireproofing.
 - 2. Coordinate construction of entrance walls with installation of door frames and sills. Maintain front wall opening until elevator equipment has been installed.
 - a. Ensure adequate support for entrance attachment points at all landings.
 - b. Coordinate wall openings for hall push buttons, signal fixtures and sleeves. Each elevator requires sleeves within the hoistway wall.
 - c. Coordinate emergency power transfer switch and power change pending signals as required for termination at the primary elevator signal control cabinet in each group.
 - d. Coordinate interface of elevators and fire alarm system.
 - e. Coordinate interface of dedicated telephone line.
 - f. Coordinate the installation of the non fused three phase permanent power disconnect in hoist way at top landing

3.4 ADJUSTING

- A. Adjust elevators for proper operation in accordance with manufacturer/installer's instructions.
- B. Adjust elevators for smooth acceleration and deceleration of car so not to cause passenger discomfort.
- C. Adjust doors to prevent opening of doors at landing on corridor side, unless car is at rest at that landing, or is in leveling zone and stopping at that landing.
- D. Adjust automatic floor leveling feature at each floor to within 1/4 inch of landing.
- E. Repair minor damages to finish in accordance with manufacturer/installer's instructions and as approved by Architect.

- F. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.5 CLEANING

- A. Clean elevators promptly after installation in accordance with manufacturer/installer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage finish.

3.6 PROTECTION

- A. Protect installed elevators from damage during construction in accordance with the negotiated temporary use agreement between Owner and manufacturer's installer.

3.7 PERMITS AND TEST

- A. The elevator contractor shall obtain and pay for all necessary permits relating to the installation of the elevator at his expense, shall make all test as required by the governing codes in effect at the time of the award.

3.8 DEMONSTRATION

- A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine and demonstrate that control systems and operating devices are functioning properly.

3.9 MAINTENANCE

- A. Perform maintenance work using competent and qualified personnel under the supervision of the elevator manufacturer or original installer.
- B. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of Owner.
- C. Provide service and maintenance of elevator system and components for one year from Date of Substantial Completion.
- D. Examine system components monthly. Clean, adjust, and lubricate equipment.
- E. Include systematic examination, adjustment, and lubrication of elevator equipment. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original equipment.
- F. Perform work without removing cars during peak traffic periods.

END OF SECTION 142105

SECTION 220250 – DIVISION OF WORK

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section delineates the division of work between Divisions 22 and 26.
 - 1. Requirements for wiring, materials, methods, and components shall be per Division 26 specifications.
 - 2. Unless otherwise indicated, control power transformers and wiring downstream of transformers required for Division 22 controls, instrumentation, motor actuators, and for plumbing equipment shall be furnished and installed under Division 22 as applicable.

END OF SECTION 220250

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Steel Pipe Sleeves: Standard weight, galvanized-steel pipe with plain ends and integral waterstop unless otherwise indicated.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Glass reinforced plastic.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of wet areas 2 inches above finished floor level.
 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade: Galvanized steel pipe sleeves.
 - 2. Concrete Slabs above Grade: Galvanized steel pipe sleeves.

END OF SECTION 220517

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.
 - 2. Bronze swing check valves.

1.3 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.
- B. ASME Compliance:
 - 1. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
 - 4. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Handlever: For quarter-turn valves NPS 6 and smaller.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded, solder, or ProPEX fitting.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel.
 - j. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- D. Do not attempt to repair defective valves or gaskets; replace with new valves and new gaskets.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
 - 2. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

3.5 DOMESTIC, COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball Valves: Two piece, full port, bronze with stainless-steel trim.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fastener systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B.

2.2 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.3 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Fastener System Installation:
 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- E. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping that will not have field-applied finish.
- D. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, the following types may be used:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 3. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
- E. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, the following types may be used:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- F. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, the following types may be used:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, the following types may be used:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete deck.

- H. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Valve tags.
 - 5. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Include in operation and maintenance manual and mount in glazed display frame in the owner designated room.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.

3. Background Color: Black.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance manual and mounted in a glazed display frame in the owner designated room.
- C. Valve Location Markers: 3/4-inch diameter, green color coded, self-adhesive tabs.
 - 1. Provide valve location markers on acoustical ceiling tiles and access panels to designate valve locations. Identify valve tag number and system type on marker.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of plumbing equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
- C. Pipe Label Color Schedule:
 - 1. Domestic Cold Water Piping:
 - a. Background Color: White.
 - b. Letter Color: Green.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; and hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape: 1-1/2 inches, round.
 - 2. Valve-Tag Color: Natural.
 - 3. Letter Color: Black.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

END OF SECTION 220553

SECTION 221100 FACILITY WATER DISTRIBUTION

PART 1 GENERAL

1.01 DESCRIPTION:

- A. This section gives the requirements for installation of water lines, including pipe, valves, and service connections and sampling stations. Excavation, trenching, and backfilling are covered in SECTION 312000 EARTH MOVING.
- B. The foreman of the contracting crew must speak fluent English.
- C. Any event requiring a UNCW Facilities representative to be present will require a 2 working day notice to schedule the event.
- D. No valves are to be operated unless a UNCW Facilities representative is present.

1.02 SUBMITTALS

- A. Test Reports: Submit all the results of the bacteriological tests to the Engineer.
- B. As-builts: Shall be submitted in accordance with Section 017839.
- C. Shop Drawings: Contractor shall furnish to the Engineer shop drawings and material specification sheets of all material and items to be installed or delivered as specified in Section 013300 Submittal Procedures.

PART 2 PRODUCTS

2.01 PIPE

- 2011 GENERAL: Water main and service shall be constructed of PVC pipe except when ductile iron is required. Water service laterals shall be constructed of CTS PE tubing.
- 2012 DUCTILE IRON PIPE shall conform to ANSI/AWWA C150/A21.50, ANSI/AWWA C151/A21.51, Thickness Class 52, with minimum pressure ratings of 350 psi for 4"-12", 250 psi for 14"-20" and 200 psi for 24" and larger, with asphalt coating and cement mortar lining unless otherwise shown or specified.
 - A. Joints shall be push-on or mechanical joints conforming to ANSI/AWWA C111/A21.11, with a minimum pressure rating of 350 psi or the specified pressure rating of the pipe, with a minimum safety factor of 2:1.
 - B. Linings for pipe and fittings shall be standard thickness cement-mortar in accordance with ANSI/AWWA C104/A21.4.
 - C. OUTSIDE COATING: The outside coating shall be a minimum of 1 mil bituminous paint according to ANSI/AWWA C151/A21.51.
- 2013 POLYVINYL CHLORIDE (PVC) PIPE AND HIGH DENSITY POLYETHYLENE (HDPE) PIPE:

- A. HDPE MAINS: Pipe shall be 2-inch minimum, SDR 9, 200 psi, and will be used for directional drilling as directed by UNCW Facilities.
- B. 2-INCH PVC MAINS: Pipe shall be ASTM D2241, IPS, Gasketed Pipe, SDR 21 minimum and shall bear the seal of NSF.
- C. 4-INCH – 12-INCH PVC MAINS: Pipe shall conform to requirements of AWWA C900 Class 150 (DR 18). Pipe shall bear the seal of NSF. Joints shall conform to ASTM D3139 or ASTM D3212.
- D. 14-INCH – 36-INCH PVC MAINS: Pipe shall conform to requirements of AWWA C905 Class 235 (DR18). Pipe shall bear the seal of NSF. Joints shall conform to ASTM D3139 or ASTM D3212.

2014 FITTINGS AND SPECIALS

- A. Fittings and specials shall be Thickness Class 52 ductile iron, mechanical joint in accordance with ANSI/AWWA C111/A21.11, ANSI/AWWA C153/A21.53, 150 pounds per square inch pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer with elastomeric gaskets. Ductile iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with ANSI/AWWA C104/A21.4. Fittings shall be for bell and spigot pipe.
- B. Buried service fittings and specials shall be suitable for 350 psi working pressure for 4"-24" and 250 psi pressure rating for 30"-64", minimum, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to C153/A21.53.
- C. Aboveground service fittings (valve vaults, valve pits, pump stations, etc.) shall be rated for 250 psi working pressure for sizes 4"-64".

2015 SERVICE LINE PIPING

Pipe shall be polyethylene (PE) tubing, SDR 9, 200 psi, conforming to ASTM D2737/AWWA C901. No joint shall be installed between the main service tap and the meter stop. In proven contaminated soil conditions, copper (Type K) services may be required at the discretion of UNCW Facilities.

2016 MECHANICAL JOINT RESTRAINT GLAND:

- A. No mild carbon steel fasteners, bolts (i.e., ASTM A307), or harnessing shall be permitted for underground service on water system components. All fasteners, bolts, and harnessing shall be stamped 316 stainless steel.
- B. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial.
- C. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the

standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist-off/Torque nuts shall be used to insure proper actuating of the restraining devices.

- D. Restraint glands shall be "Megalug" with Megabond as manufactured by EBAA Iron, Inc., or "Camlock" with Flexi-Coat as manufactured by Smith-Blair, Inc., "Stargrip" with Starbond, as manufactured by Star Pipe, or equal. .

2017 Rodding could be situation specific (with 316 stainless steel rods and nuts).

2018 PACKING MATERIALS AND JOINTS

No contaminated material or any material capable of supporting prolific growth of micro-organisms shall be used for sealing joints. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water and shall conform to AWWA C111/A21-11. It shall be delivered to the job in enclosed containers and shall be kept clean. If proven contaminated soil conditions exist, Nitrile or Neoprene Gaskets may be required by the sole discretion of the UNCW Facilities Representative.

2019 If 316 stainless steel is not available, submit alternate for Engineer approval.

2.02 VALVES

2021 VALVES: Iron body, bronze mounted, double disc, parallel seat type meeting the full requirements of AWWA C500, or resilient seated valves in conformance with AWWA C509 or C515. Valves larger than 16-inches shall be fully-ported gate valves and require side gear box if cover is not sufficient. Valves shall have 2-inch operating nut and open left, and shall have O-ring seals. Valve ends shall be mechanical joint, unless otherwise shown or specified. The valve bonnet shall have 316 stainless steel fasteners. The coating on the valve shall conform to AWWA C550 and ANSI/NSF 61. Valves shall be manufactured by Mueller, American Darling or Clow Corporation or approved equal.

2022 VALVE BOXES: Square nut valve boxes shall be cast iron screw adjustment type with flared base. The word "WATER" shall be cast in the cover. The boxes shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at the valve location. Boxes shall be installed over each gate valve, unless otherwise shown or specified. Valve boxes shall conform to ASTM A48 "Grey Iron Castings" Class 30B or approved equal.

2023 VALVE BOX CONCRETE COLLARS: Valve boxes in unpaved areas shall be installed with either pre-cast or poured in place concrete collars.

2.03 FIRE HYDRANTS: Hydrant valves shall open left. Hydrants shall be iron body, fully bronze mounted, dry barrel type with breakaway flange and stem coupling conforming to AWWA C502, with valve opening not less than 4.5-inches in diameter. Hydrants shall have a 6-inch mechanical joint connection on the inlet end. Outlets shall have 5" STORZ and 2-1/2" American National Standard fire hose coupling threads. Working parts shall be bronze. Hydrants shall be Mueller, American Darling, Clow or approved equal.

2.04 WATER SAMPLING STATIONS: Sampling stations shall be installed on all 2-inch or larger services and mains or as directed by UNCW Facilities or the Engineer. The sampling station shall be installed immediately upstream of the reverse backflow preventer or as directed by UNCW Facilities or the Engineer. The sampling station shall be the Eclipse No. 88 model by the Kupferle Foundry Company, or approved equal. A ground collar shall be placed around the sampling station and embedded to a minimum depth of 6-inches and the annular space

between the ring and sampling station shall be filled with washed stone, #57 or equivalent.

2.05 SERVICE LINE ITEMS

2051 SERVICE TAPS – 1 INCH

- A. SERVICE SADDLES: Saddles for PVC main shall be wide band brass body service saddles, McDonald 3801 series, Mueller H 13000 series, or approved equal. Saddles for ductile iron pipe shall be Smith Blair Model 313 or approved equal, hardware shall be 316 stainless steel. Size of tap shall match that of the service line (1-inch minimum tap).
- B. CORPORATION STOP: Connection stop shall have compression nut and gasket service line connections. Size of corporation stop shall match that of service line. Corporation stop shall be McDonald Model 4701B-22, Mueller Model P-15008, or approved equal. Stainless steel insert stiffeners, 1-inch diameter, McDonald Part Number 6133T or approved equal shall be used on all compression fittings.
- C. THREADS: shall be corporation cock threads.

2052 SERVICE TAPS – 2-INCH and 3-INCH

- A. SERVICE SADDLES: Saddles for PVC mains shall be wide band, 2 pieces, brass body (McDonald 3801 Series) Ford S90 (double strap) or bronze body (Mueller Series H-13000). No three-piece service saddles are permitted.
- B. TAPPING SLEEVE/VALVE: The tapping valve shall be a 2-inch or 3-inch, Resilient Wedge Gate Valve, AFC 2502 SS or approved equal.
- C. VALVE BOXES: A valve box as specified in the specifications shall be installed with the 2-inch tapping valve and larger.

2053 SINGLE SERVICE LINE

- A. COMPRESSION ADAPTER FITTINGS: Service stops shall have compression adapter fitting for connection to 1-inch diameter (minimum) PE water service line and shall be McDonald Model 4753-22 or approved equal. Stainless steel insert stiffeners, 1-inch diameter, McDonald Part Number 6133T or approved equal shall be used on all compression fittings.
- B. SERVICE ANGLE STOPS: Service stop shall have threaded fitting for connection to compression adapter and shall be McDonald Model 4642B, or approved equal.

2054 SERVICE INTENDED FOR FIRE PROTECTION:

- A. UNCW provides potable water service which may be interrupted for repairs, system expansion, or other general requirements. UNCW does not guarantee adequate fire flow for protection of life or property. There shall be no domestic use taps allowed on a dedicated fire line. Some facility owners choose to utilize this interruptible potable water supply from the UNCW system for fire protection. If facility owners choose to utilize the potable water system for fire protection flow, the service for fire protection shall be configured in one of two methods:
- B. Two taps shall be installed, one for potable water and one for fire flow. The potable water tap shall be installed and metered in accordance with UNCW Facilities.

Each building shall have an independent water meter inside the building per NC GS 668.

- C. A privately owned, privately maintained backflow prevention assembly shall be installed per the North Carolina State Building Code and in accordance with UNCW Facilities requirements. The backflow prevention assembly will be of the detector type to allow detection of leakage downstream. Backflow prevention shall be installed inside each building.

2.06 PIPE LOCATION WIRE:

- A. Pipe locator wire shall be installed on all non-metallic main lines, hydrant legs and services as per specifications. A 14 gauge insulated copper wire rated for underground waterproof application. All splices in the wire shall be made with 3M DBR Direct Bury Splice Kit an underground rated, watertight, and approved splice connector or approved equal.
- B. All underground utilities shall be marked with marking tape, 3-inches in width. The marking tape shall be permanent, bright-colored, continuous plastic tape, intended for direct burial and identifying type of service. The tape should be installed between 6-inches minimum depth to a maximum of 24-inches deep. Tape shall be of color-coded background with imprinted letters to most accurately reflect the type of service buried.

PART 3 EXECUTION

- 3.01 GENERAL: Install pipe in strict conformance with AWWA C600. Minimum depth of bury above the top of pipe shall be 36 inches unless ductile iron pipe is used. Install plastic pipe in conformance with ASTM D2774 and recommended practices of the UNI-BELL Plastic Pipe Association (www.uni-bell.org)
- 3.02 CUTTING OF PIPE: Cut pipe in a neat and workmanlike manner without damage to the pipe or its lining.
- 3.03 ADJACENT FACILITIES: Refer to specification for Gravity Sanitary Sewer for adjacent facility locations.
- 3.04 JOINT DEFLECTION: Maximum joint deflection shall meet requirements of AWWA C600 or AWWA Manual of Practice M23.
- 3.05 PIPE LOCATOR WIRE: The locator wire shall be run continuously along the pipe and shall be securely taped to the top of the water line and all service laterals. The locator wire shall not be wrapped around the pipe, flanges, bells, valves, or other appurtenances. The locator wire shall be accessible above ground at one thousand feet (1,000') intervals and shall be protected by a cast iron box with cover marked "water" with a concrete collar. At valve boxes, the wire shall be brought up on the outside of the box, a hole is to be drilled with a grommet near the top of the valve box for wire to be taped to the inside of the box for protection. At valve boxes, the wire shall be brought up on the outside of the box, a hole is to be drilled with a grommet near the top of the valve box for wire to be taped to the inside of the box for protection. The contractor is required to verify and certify the continuity of the locator wire in the presence of UNCW Facilities before the line is accepted using low frequency line tracing equipment.
- 3.06 JOINTING OF PIPE
 - 3.06.1 KEEPING PIPE CLEAN AND DRY: Precautions shall be taken to protect pipe

interiors, fittings and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. When pipe laying is not in progress, for example, at the close of the day's work, all openings in the pipeline shall be closed by water-tight plugs. Joints of all pipe in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry. It is recommended that only the amount of pipe to be installed that day be strung out.

Note: Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipe laying, the less this delay. If the dirt will not be removed by the flushing operation in the opinion of the Owner's Engineer, the interior of the pipe shall be cleaned and swabbed as necessary, with a five (5%) percent hypochlorite disinfecting solution @ 300 mg/L residual.

- 3.06.2 DUCTILE-IRON PIPE shall be installed in accordance with AWWA C600, modified as necessary by the recommendations of the manufacturer.
- 3.06.3 PVC PIPE shall be installed in accordance with AWWA Manual of Practice M23, modified as necessary by the recommendations of the manufacturer.
- 3.06.4 CONNECTIONS between different types of pipe and accessories shall be made with transition fittings approved by UNCW Facilities Representative.
- 3.06.5 SERVICE LATERALS: Service laterals shall consist of a tapping saddle, corporation stop and a length of PE pipe with no joint installed between the main service tap and the service stop. Service laterals shall be installed perpendicular to the water main. Contractor shall install all material per the detail allowing for meter installation at a later date by UNCW Facilities personnel. Locator wire shall be installed as per specifications.
- 3.07 SETTING OF VALVES, VALVE BOXES AND FIRE HYDRANTS
 - 3.07.1 GENERAL: Install where shown or directed and set plumb on a brick foundation. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet.
 - 3.07.2 VALVES after delivery shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Valves shall be fully opened and fully closed to insure that all parts are in working condition.
- 3.08 RESTRAINING AND BLOCKING

The plugs, caps, tees and bends deflecting 11 1/4 degrees or more either vertically or horizontally on water lines 6 inches in diameter or larger shall be provided with thrust blocking or "Megalug" or Camlok retainer gland at each joint, installed per manufacturer's requirements. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust blocks shall be poured directly against undisturbed earth, with a blocking cure time of 5 days. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown on the plans or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Rods and clamps shall be 316 stainless steel.

3.09 FIRE HYDRANTS

Locate and install as shown on the drawings. Each hydrant shall be connected to the main with a 6-inch branch line. Hydrants shall be set plumb with the pumper nozzle facing the roadway and with the center of the lowest outlet not less than 18 inches above the finished surrounding grade and the operating nut not more than 48 inches above the finished surrounding grade. The hydrant shall be set in a bed of crushed rock which shall surround the barrel at least 12 inches in all directions. Hydrants shall be restrained with 316 stainless steel tie rods extending from the main line tee to the hydrant, or by combination of tie rods and blocking or by "Megalug" retainer glands at each joint per manufacturer's requirements. Hydrant valves shall be located at the main as close to the tee or tap as possible, 18" maximum. Hydrants to be equipped with a 5-inch Storz Connection.

3.10 HYDROSTATIC TESTING

3.101 GENERAL: After all water mains and appurtenances are installed and where any section of a water line is provided with concrete thrust blocking, the hydrostatic test shall not be made until at least 5 days after installation of the concrete thrust blocking unless otherwise approved. The method proposed for disposal of wastewater from hydrostatic tests and disinfection shall be submitted to the Owner's representative prior to performing hydrostatic tests. Use clean potable water for all testing of lines. The contractor is to contact the UNCW Facilities representative to schedule the observation of any valves to be operated for flushing and pre-testing.

3.102 PRESSURE TEST

- A. For purposes of testing, working pressure shall be 100 psi and test pressure shall be 150 psi. Air testing will not be accepted on mains and services, (Only Hydrostatic Testing is allowed), but will be accepted for saddles, 40 psi for 15 minutes. The pressure gauge must be liquid filled with 2 psi increments maximum. The gauge must be a minimum of three feet above grade. No more than 3 psi can be lost during the two-hour test. The gauge must return to 0 psi when the test is completed.
- C. Pressure test in strict conformance with AWWA C600, Section 4.1 and 4.2. Test for leakage in conformance with AWWA C600, Section 4.2, Table 6, which shows allowable leakage per 1000 ft. of pipeline allowed. Remedy all visible leaks and locate and repair leakage in lines which exceed the specified amounts.
- D. The contractor is to contact the UNCW Facilities representative with a 48-hour notice, to schedule the observation of any test. The contractor will pre-test the lines prior to the UNCW Facilities representative arrival. The contractor is to cancel the test if the lines will not pass the required test and remedy all visible leaks and locate and repair leakage in lines which exceed the specified amounts. When completed, the contractor will re-schedule the test.

3.11 DISINFECTION

3.11.1 DISINFECTING WATER MAINS, FIRELINES AND 4" OR LARGER SERVICES

- A. Each unit of constructed water main shall be disinfected with chlorine upon successful completion of the hydrostatic test. The disinfection procedure shall be performed in strict conformance with the below.

- B. The Contractor shall pay particular attention to the scheduling requirements outlined in the procedures. The Contractor shall be responsible for furnishing and installing all required chlorine injection and monitoring ports at no additional cost to the Owner.
- C. The mains will in no case be accepted by the Owner for public use until the Engineer approves the mains as having been properly disinfected.

3112 PROCEDURES FOR DISINFECTING WATER MAINS

A. GENERAL INTENT

It is the intent of these procedures to present essential steps for disinfecting new and repaired water mains. All steps must be initiated and complied with in order for permission to be given for these water lines to be opened for use. Pressure testing must be completed and approved before chlorination procedures are started

B. BASIC PROCEDURES

The basic procedure comprises:

1. Preventing contaminated materials from entering the water mains during construction or repair and removing by flushing materials that may have entered the water main.
2. Disinfecting any residual contamination that may remain.
3. Determining the bacteriological quality by laboratory test after disinfection.

C. STANDARD OF REFERENCE

All procedures herein shall comply with the AWWA Standard C651-92 for Disinfection of Water Mains or the latest revision.

D. CHLORINATION PLANNING

The planning process prior to chlorination involves checking the design plan for the correct installations and layout needed for chlorination, routing, the chlorine solution and numbering blowoff sample points, calculating the required amount of chlorine, and determining the required amount of time to properly chlorinate the system. Planning is necessary to ensure that newly installed pipes are chlorinated properly and safely.

Before calling the UNCW Facilities office for a time to be set up for disinfection, all of the following must be installed or supplied by the Contractor at no cost to the Owner. Also, this list should be checked and/or assembled before Engineering personnel arrive.

1. The line or lines to be disinfected should be connected to the UNCW water system (main). A valve should be installed in the line to be disinfected near the water main connection.
2. A blowoff of an approved material, or brass faucet should be installed at the dead end of the line and every 1,200 feet to be disinfected for flushing purposes and bacteria sampling. The opening to this blowoff should point downward, and there should be at least twenty-four inches clearance between the opening and the ground for proper sampling.
3. Copper or PVC blowoffs should be at all closed valves.
4. Mains connecting other mains with open valves within the system to be disinfected may cause "short circuits" resulting in improper disinfection. Valves

on these connecting mains should be checked to see if they should be closed to eliminate this problem. Copper blowoffs should be at both sides of valves closed to prevent "short circuits".

5. The pressure test of the line needs to pass before attempting disinfection procedures.
6. A clean container is necessary to mix and/or dissolve the hypochlorite.
7. A clean, new wooden mixer should be present for mixing and dissolving the hypochlorite.
8. A pump for pumping the chlorine solution into the line should be present. This pump should be gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solutions may be fed with a hand pump; for example, a hydraulic test pump. Feed lines shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.
9. All temporary blowoffs and injection points shall be properly abandoned and physically disconnected when directed by UNCW Facilities prior to the line being placed into service.
10. FORMS OF CHLORINE TO BE USED - The forms of chlorine that are to be used for the purpose of disinfection operation or water main repairs are sodium hypochlorite solution or calcium hypochlorite granules, conform to ANSI/AWWA B300.

E. PRELIMINARY FLUSHING

Flushing is the process of flowing water through a pipe to remove foreign particles which could cause contamination or blockage within the water system. All mains should be flushed prior to chlorination. The minimum amount of water required to flush a main is 1 ½ times the capacity of the main (capacity and time may be calculated using the chart below). A minimum velocity of 2.5 feet per second, but preferably 3.5 feet per second, should be maintained within the pipe to ensure that it is properly scoured. No site for flushing should be chosen unless it has been determined that drainage is adequate for this site.

<u>Diameter of Line (Inches)</u>	<u># Gal/Ft</u>
16	10.50
12	5.87
8	2.62
6	1.47
2	0.16

Multiply the # gal/ft for the size line by the length of line in feet. This will give you the number of gallons the pipe will hold.

NOTE: Flushing is no substitute for preventative measures taken before and during pipe laying. Certain contaminants, especially in caked deposits, resist flushing at any velocity. Furthermore, with diameters of 16 inches, even the minimum recommended flushing velocity of 2.5 feet/second is sometimes difficult to achieve.

Temporary blowoffs are a means of releasing water from a main for flushing. They are normally placed at "dead ends" and at each side of closed valves. A blowoff usually consists of a corporation stop, a length of pipe, and a curb stop at ground level; however, a blowoff on a large water main may consist of a gate valve and a length of pipe. Blowoffs are to be installed by the contractor installing the new water main. All permanent blowoffs shall be installed in accordance with standard details and specifications.

3113 DISINFECTION PROCEDURES AFTER CUTTING INTO OR REPAIRING EXISTING MAINS

The following procedures apply primarily when mains are wholly or partially dewatered. After the appropriate repair procedures have been completed, the existing main may be returned to service prior to completion of the bacteriological testing to minimize the time customers are out of water. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure present little danger of contamination and require no disinfection.

A. MAIN DISINFECTION

1. Swabbing, Flushing and Sampling. The following procedure is considered as a minimum that may be used.
 - a. SWABBING WITH HYPOCHLORITE SOLUTION. The interior of all pipe and fittings used in making repair (particularly couplings and tapping sleeves) shall be swabbed with a five (5) percent hypochlorite solution (300 mg/l concentration) before they are installed.
 - b. FLUSHING. Thorough flushing is the most practical means of removing contamination introduced during repairs. If valve and hydrant locations permit, flushing toward the work location from both directions independently is recommended. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water and particulate matter are eliminated.
 - c. SLUG CHLORINATION: When practical, in addition to the procedures above, the section of main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated with a high concentration of chlorine (as much as 300 mg/L), and the concentration allowed to stay in contact with the main for a minimum of 15 minutes. After chlorination, flushing shall be resumed and continued until discolored water is eliminated and the water is free of noticeable high chlorine odor. A chlorine residual of no greater than 3.0 mg/L shall be acceptable.
 - c. SAMPLING. Bacteriological samples shall be taken after repairs are completed to provide a record for determining the procedures effectiveness. If the direction of flow is known, sample locations shall be determined. If the direction of flow is unknown, then samples shall be taken on each side of the main break. If bacteriological samples are unacceptable, the UNCW Facilities representative and Engineer will determine corrective action. Daily sampling shall be continued until two successive daily samples are acceptable.

3114 SPECIFICATIONS FOR DISINFECTION OF WATER DISTRIBUTION MAINS

A. GENERAL

1. SCOPE: This standard presents essential procedures for disinfecting new and repaired water mains. All new water mains shall be disinfected before they are placed in service. All water mains taken out of service for inspection, repair, or other activities shall be disinfected before they are returned to service.
2. REFERENCES: This standard references the following documents. The latest current edition of each forms a part of this standard where and to the extent specified herein. In case of any conflict, the requirements of this standard shall prevail.

ANSI/AWWA C651 - 14	Disinfecting Water Mains ANSI/AWWA B300 Standard for Hypochlorites AWWA Manual - M3 Safety Practices for Water Utilities
AWWA Manual - M20	Water Chlorination Principles and Practices
AWWA Manual - M12	Simplified Procedure for Water Examination
APHA, AWWA, WEF	Standard Methods for the Examination of Water and Wastewater

3. RECORDS OF COMPLIANCE: The records of compliance shall be the following:
 - Coliform Bacteria: Zero coliforms per 100 ml sample
 - Chlorine Residual: Chlorine residual equivalent to the source water concentration

B. BASIC DISINFECTION PROCEDURES

The basic disinfection procedure consists of:

1. Preventing contaminating materials from entering the water main during storage, construction, or repair.
2. Removing by flushing or other means, those materials that may have entered the water main.
3. Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.
4. Protecting the existing distribution system from backflow due to hydrostatic pressure test and disinfection procedures.
5. Determining the bacteriological and other related quality by laboratory testing after disinfection.
6. Final connection of the approved new water main to the active distribution system.

C. PREVENTIVE AND CORRECTIVE MEASURES DURING CONSTRUCTION

Heavy particulates generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing such organisms. It is, therefore, essential that the procedures of this section be observed to assure that a water main and its appurtenances are thoroughly clean for the final disinfection by chlorination. Also, any connection of a new water main to the active distribution system prior to receipt of satisfactory samples may constitute a cross-connection. Therefore, the new main must be isolated until all bacteriological and other tests are satisfactorily completed.

1. **KEEPING PIPE CLEAN AND DRY:** Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize the entrance of foreign material. All openings in the pipeline shall be closed with watertight plugs when work is stopped at the end of the day or for other reasons.
2. **JOINTS:** Joints of all pipes in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.
3. **PACKING MATERIAL:** All packing material shall consist of molded or tubular rubber rings, or other approved material. Lead or asbestos material in any form shall not be permitted.
4. **SEALING MATERIALS:** No contaminated material or any material capable of supporting prolific growth of microorganisms shall be used for sealing or lubricating joints. Sealing and lubricating material or gaskets shall be handled in a manner that avoids contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. It shall be delivered to the job in closed containers and shall be kept clean. Soil conditions could warrant the upgrade of gasket material to a volatile resistant material.
5. **CLEANING OF PIPE AND APPURTENANCES:** If dirt enters the pipe, it shall be removed and the interior pipe surface cleaned. If, in the opinion of the UNCW Facilities representative, the dirt remaining in the pipe will not be removed by the flushing operation, then the interior shall be cleaned by mechanical means such as a hydraulically propelled foam pig or other suitable device. The cleaning method used shall not force mud or debris into the interior pipe joint spaces and shall be acceptable to UNCW Facilities.
6. **FLOODING BY STORM OR ACCIDENT DURING CONSTRUCTION:** If the main is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is clean. The section of pipeline shall be flushed until water from the pipe runs clear.

D. METHOD OF CHLORINATION

The contractor shall use the continuous feed method for disinfection of all new water mains. This method must give a minimum of 10 mg/L of chlorine residual at the end of the 24-hr period.

1. **CONTINUOUS-FEED METHOD:** The continuous-feed method is the process in which a concentrated solution of chlorine is injected into the water main. Caution shall be observed during the handling and injection of the chlorine solution as chlorine in any form is very toxic and any error could be harmful to the employees and to the public.
2. **PRELIMINARY FLUSHING:** Prior to any disinfection procedures being performed, all hydrostatic tests shall have been completed and accepted by the UNCW Facilities representative. Before chlorine solutions are injected, the main shall be filled with potable water to eliminate air pockets and shall be flushed to remove particulates. The flushing velocity in the main shall not be less than 2.5 ft/sec (preferably 3.5 ft/sec) unless the UNCW Facilities

representative determines that conditions do not permit the required flow or that the flow will cause undue problems when discharged to waste. An acceptable flushing velocity shall then be determined and used.

3. PROCEDURE FOR CHLORINATING THE MAIN

- a. Water supplied from the existing distribution system or other approved public water supply shall be made to flow at a constant, measured rate into the newly installed water main. In the absence of a meter, the rate may be approximated as best can be determined.
- b. At a point not more than 10 ft downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 50 mg/L and not greater than 100 mg/L free chlorine residual. To ensure that this concentration is provided, measure the chlorine concentration at regular intervals of distance and time in accordance with the procedures described in the current edition of *Standard Methods for the Examination of Water and Wastewater* or AWWA Manual M12, or by using appropriate chlorine test kits (see appendix B).
- c. During the application of the chlorine, valves shall be adjusted by or under the supervision of the UNCW Facilities representative to prevent the chlorine solution from flowing back into the existing water system. The chlorine injection shall not cease until the entire water main is filled with a chlorine concentration of not less than 50 mg/L. All appurtenances and valves shall be operated to ensure that the chlorine solution has contact with them. The chlorinated water shall be allowed to remain for a period of not less than 24-hours.
- d. At the end of the 24-hour period, the chlorine residual shall be measured and shall not be less than 10 mg/L in any samples collected along the water main and at the end of said water main.

E. FINAL FLUSHING

1. CLEARING THE MAIN OF HIGHLY CHLORINATED WATER: Highly chlorinated water should not remain in prolonged contact with pipe. At the end of the 24-hour contact period, the water should be removed in order to prevent damage to the pipe lining or corrosion damage to the pipe itself. The highly chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system.
2. DISPOSING OF HIGHLY CHLORINATED WATER: A neutralizing chemical shall be applied to the chlorinated water to be discharged to neutralize thoroughly the chlorine residual remaining in the water (see appendix B). Where necessary, federal, state, and local regulatory agencies should be contacted to determine special provisions for the disposal of the neutralized water.

F. BACTERIOLOGICAL AND OTHER TESTS

1. STANDARD CONDITIONS: After final flushing and before the new main is opened to the distribution system, two consecutive sets of acceptable

samples, taken at least 24-hours apart, shall be collected from the new main. Samples shall be collected from every 1200-ft of new water main, from the end of the water line, and from each branch. All samples shall be tested in accordance with *Standard Methods for the Examination of Water and Wastewater*. All samples shall show the absence of coliform organisms, and a free chlorine residual equal to the level present in the existing system and shall have no visible color or particulate matter. Must be submitted in the form of an official report by a certified lab.

2. SPECIAL CONDITIONS: If in the opinion of UNCW Facilities, excess contamination has been allowed to enter the water main during construction or other events, bacteriological samples shall be taken at intervals of approximately 400 to 500 ft and shall be identified by location. Samples shall be taken of water that has stood in the new main for at least 16 hours after final flushing has been completed.
3. SAMPLING PROCEDURES: A copper or PVC assembly or a combination blowoff and sampling tap may be used for mains up to 8-inches diameter. Fire hydrants may not be used for sampling purposes. After samples have been collected, analyzed, and accepted, the sampling assemblies may be removed and retained for future use. All bacteriological analysis must be completed by a N.C. certified Drinking Water laboratory. The utility contractor shall be responsible for all costs associated with the sampling and analysis of all samples required for acceptance. All Lab Reports shall be Delivered to the UNCW Facilities Representative before any activation can proceed.

G. REPEAT DISINFECTION OF WATER MAIN

If the initial disinfection fails twice to produce satisfactory results as per specifications, the new main shall be reflushed, rechlorinated and resampled; UNCW Facilities may also require further cleaning methods (i.e. pigging the line) if the disinfections fails twice. If check samples also fail to produce acceptable results, the new main shall be reflushed and rechlorinated by the continuous-feed method of chlorination until satisfactory results are obtained.

NOTE: High velocities in the existing system, resulting from flushing the new main may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is advisable to also sample water entering the new main.

H. CONNECTION TO EXISTING SYSTEM

The NCPWS certifications, final acceptance, opening of valves and activation of the existing water system will only be allowed after satisfactory samples and chlorine levels have been produced. All sampling devices and blowoffs must be removed from the water main by the contractor prior to acceptance by UNCW Facilities. The UNCW Facilities Department will activate the system when their procedures are completed.

I. CHLORINE RESIDUAL TESTING

Several manufacturers produce high-range and low-range chlorine test kits that are inexpensive, easy to use, and satisfactory for the precision required. Before line is flushed, but after 24 hours, a minimum of 10 mg/L of free Chlorine, Cl_2 , must reside in the line. The test kits should use methodology conforming with *Standard*

Methods for the Examination of Water and Wastewater or AWWA Manual M12.
Examples of such manufacturers include:

- Hach Company
- LaMotte
- Fisher Scientific
- Hellige

J. DISPOSAL OF HIGHLY CHLORINATED WATER

Chlorine residual of water being disposed will be neutralized by treating with one of the chemicals listed below:

- Ascorbic Acid
- Sulfur Dioxide
- Sodium Bisulfate
- Sodium Sulfite
- Sodium Thiosulfate

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.

1.3 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Domestic water pipe and fittings.
 - 2. Dielectric fittings.
- B. Water Samples: Specified in "Cleaning" Article.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
 - 1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 4. Copper Pressure-Seal-Joint Fittings:
 - a. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.2 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.3 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.

- b. Central Plastics Company.
- c. Hart Industries International, Inc.
- d. Jomar International Ltd.
- e. Matco-Norca, Inc.
- f. McDonald, A. Y. Mfg. Co.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- h. Wilkins; a Zurn company.

2. Description:

- a. Standard: ASSE 1079.
- b. Pressure Rating: 150 psig.
- c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Capitol Manufacturing Company.
- b. Central Plastics Company.
- c. Matco-Norca, Inc.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- e. Wilkins; a Zurn company.

2. Description:

- a. Standard: ASSE 1079.
- b. Factory-fabricated, bolted, companion-flange assembly.
- c. Pressure Rating: 150 psig.
- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations.
- B. Install shutoff valve and hose-end drain valve inside the building at each domestic water service entrance.
- C. Install domestic water piping level without pitch and plumb.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install piping to permit valve servicing.
- H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install sleeves for piping penetrations of walls, floors, and exterior walls above grade.
- L. Install sleeve seals for piping penetrations of exterior concrete walls below grade.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support products and installation.
 - 1. Install pipe hangers for horizontal piping.
 - 2. Install pipe support clamps for vertical piping.
 - 3. Vertical Piping: MSS Type 8 or 42, clamps.
 - 4. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

3.8 IDENTIFICATION

- A. Identify system components.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Close shutoff valves to branch distribution piping serving fixtures and equipment.
 - 5. Cap and subject piping to a static water pressure of 125 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 6. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 7. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, and hose bibbs.
 - 2. Open shutoff valves to fully open position.

3. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
4. Remove and clean strainer screens. Close drain valves and replace drain plugs.
5. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Domestic water piping shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.
2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper solder-joint fittings; and soldered joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller.
2. Drain Duty: Hose-end drain valves.

The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Backflow preventers.
 - 2. Hose bibbs.
 - 3. Air vents.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers - Domestic Water Systems:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO.
 - d. Watts; a Watts Water Technologies Company.
 - e. Zurn Industries.
2. Standard: ASSE 1013.

B. Hose Bibbs:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products.
 - f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - g. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
2. Standard: ASME A112.18.1 for sediment faucets.

2.2 AIR VENTS

A. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

PART 3 - EXECUTION

3.1 INSTALLATION

- #### A.
1. Install backflow preventers for each water supply to comply with authorities having jurisdiction.

1. Locate backflow preventer in a heated enclosure.
2. Do not install bypass piping around backflow preventers.

B. Install air vents at high points of water piping.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of piping and specialties.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

END OF SECTION 221119

SECTION 221413 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.
 - 2. Elevator Drainage, Pump Discharge Piping: 50 psig.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ANACO-Husky.

- b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.
 - g. Stant.
 - h. Tyler Pipe.
- 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.2 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Solvent Cement: ASTM D 2564.
 - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers"

2.3 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

- B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- C. Install piping at indicated slopes.
- D. Install piping free of sags and bends.
- E. Install fittings for changes in direction and branch connections.
- F. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Storm Drain: 1/8 inch per foot downward in direction of flow.
 - 2. Horizontal Storm-Drainage Piping: 1/8 inch per foot downward in direction of flow.
- I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- J. Install underground PVC piping according to ASTM D 2321.
- K. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- L. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
 - 2. Install drains in storm drainage gravity-flow piping.
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- N. Install sleeves for piping penetrations of walls, floors, and exterior walls above grade.
- O. Install sleeve seals for piping penetrations of exterior concrete walls below grade.

3.3 JOINT CONSTRUCTION

- A. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

- B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.4 VALVE INSTALLATION

- A. Shutoff Valves: Install full port ball valve on each sump pump discharge.
- B. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices.
 - 1. Install pipe hangers for horizontal piping.
 - 2. Install pipe support clamps for vertical piping.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 4. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6 and Larger: 60 inches with 3/4-inch rod.
 - 5. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.

- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2: 96 inches with 3/8-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to parking deck drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 - 2. Install expansion joints at the roof drain outlets where connections are made to vertical conductors that are free of offsets.
- D. Connect pump-discharge piping to the following:
 - 1. Sump Pumps: To sump pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

- A. Identify exposed storm drainage piping.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.
- E. Test pump-discharge piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 4. Prepare reports for tests and required corrective action.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

- A. Aboveground, storm drainage piping shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
- B. Underground, storm drainage piping shall be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Elevator drainage pump-discharge piping shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and soldered joints.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Parking deck drains.
 - 2. Miscellaneous storm drainage piping specialties.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL PARKING DECK DRAINS

- A. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group.
 - 2. Standard: ASME A112.6.4, for general-purpose parking deck drains.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Size: Same as connected drainage piping
2. Body Material: Hubless, cast-iron soil pipe test tee.
3. Closure: Raised-head, brass plug.
4. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.

C. Cast-Iron Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group.
2. Standard: ASME A112.36.2M. Include wall access.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install parking deck drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 1. Install flashing collar or flange of parking deck drain to prevent leakage between drain and adjoining deck. Maintain integrity of waterproof membranes where penetrated.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical conductor.
- C. For floor cleanouts for piping below floors, install cleanout cover with top flush with finished floor.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Submersible sump pumps.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Bell & Gossett Domestic Pump; ITT Corporation.
 - b. Goulds Pumps; ITT Corporation.
 - c. Grundfos Pumps Corp.
 - d. Liberty Pumps.
 - e. Little Giant Pump Co.
 - f. Stancor, Inc.
 - g. Weil Pump Company, Inc.
 - h. Zoeller Company.
2. Description: Factory-assembled and -tested sump-pump unit.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements.
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Perform each visual and mechanical inspection.
 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- B. Pumps and controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

END OF SECTION 221429

SECTION 230250 – DIVISION OF WORK (DIVISIONS 21, 22, 23, 26, and 28)

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section delineates the division of work between Divisions 21, 22, 23, 26, and 28.
 - 1. Requirements for wiring, materials, methods, and components shall be per Division 26 specifications.
 - 2. Individual motor starters, controls, relays, contactors, and switches (other than disconnects fed from a service transformer), control power transformers, and variable frequency drives (VFD) for mechanical equipment shall be furnished under Division 23, and for plumbing equipment shall be furnished under Division 22, and installed under Division 26 except where they are specified under and identified to be installed by Division 26 or they are not part of any mechanical or plumbing piece of equipment. Motor-rated toggle switches shall be furnished under Division 23 or Division 22 as applicable and installed under Division 26 and sized in accordance with equipment nameplate data. Separate ground wire sized per NEC shall be provided. Temperature and low voltage controls are to be installed under Division 23, or as applicable under Division 22. Power wiring is to be furnished and installed under Division 26.
 - 3. Disconnect switches for equipment fed directly from a service transformer shall be furnished and installed under Division 26.
 - 4. Wiring and raceway shall be provided under Division 26 up to a termination point consisting of a starter, control power transformer, VFD, motor-rated toggle switch, or disconnect switch. Line side terminations shall be provided under Division 26. Branch circuit wiring and raceway from the termination point to the mechanical equipment, including final connections, shall be provided under Division 23.
 - 5. An additional disconnect switch, furnished under Division 23 and installed under Division 26, shall be required "within sight" of the equipment/motor per Code if the upstream disconnect switch, starter, or VFD is remotely located or not "within sight".
 - 6. Temperature and low voltage controls should be installed under Division 23. Relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aqua-stats, freeze-stats, line and low voltage thermostats, thermals, remote selector switches, remote push-button stations, emergency break-glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 23 shall be furnished, installed, and wired under Division 23.
 - 7. Unless otherwise indicated, control power transformers and wiring downstream of transformers required for Division 23 controls, instrumentation, motor actuators, and for plumbing fixtures shall be furnished and installed under Division 23.
 - 8. Duct mounted smoke detectors including detectors used for control of combination fire/smoke dampers shall be furnished and wired by Division 28, installed by Division 23. Fire alarm ERV shutdown circuits shall be wired from the fire alarm control unit to a termination point adjacent to the ERV controls, under Division 28. ERV control wiring from the termination point to the equipment shall be under Division 23.
 - 9. Smoke Damper and Combination Fire and Smoke Dampers:

- a. Control power transformers and associated enclosures required for the operation and position monitoring of smoke dampers or combination fire and smoke dampers shall be furnished and installed under Division 23.
 - b. Branch circuit wiring and raceway to the primary side of control power transformers shall be furnished, installed, and terminated under Division 26.
 - c. Wiring and raceway on the secondary side of control power transformers throughout the remaining portion of the damper wiring assembly, including but not limited to, wiring required to connect damper actuators, position indicator switches and remote test pushbuttons shall be furnished, installed, and terminated under Division 23, except terminations at fire alarm control relays shall be under Division 28.
10. Sprinkler flow and tamper switches shall be furnished and installed under Division 21 and wired under Division 28.

END OF SECTION 230250

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeve-seal fittings
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting.
 - 9. Concrete bases.
 - 10. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
 - 4. PP: Polypropylene plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. All accessories, appurtenances, hangers, supports, material, equipment and labor necessary for the resulting systems to be complete, operational systems are to be provided.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure before installation and during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic, Carbon steel, or Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 SLEEVE-SEAL FITTINGS

- A. Available Manufacturers:
 1. Presealed Systems.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends and welded steel collar.
- C. Cast Iron: Cast or fabricated "wall pipe" of cast or ductile iron material equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve operation and servicing. Installation is to produce space for complete range of movement of valve operator (handle, wheel, etc.) and operators hand or hands.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation and jacketing.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

- b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Provide extended sleeves for core drilled holes to minimize the potential of water leaks cascading down to lower floor.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- O. Cut sleeves to length for mounting flush with both surfaces.
- 1. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- P. Install sleeves in new walls and slabs as new walls and slabs are constructed.
- Q. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and outside of pipe or between sleeve and pipe insulation if pipe is insulated. Use the following sleeve materials:
- 1. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - 2. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
 - 3. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
- a. Seal space outside of sleeve fittings with grout.
- R. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- S. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten

bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- T. Underground Exterior-Wall and Slab On-grade and Below Grade Floor Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- U. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- V. Verify final equipment locations for roughing-in.
- W. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install HVAC equipment to facilitate service, maintenance, testing, adjusting, balancing and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions applicable for the equipment being installed, but not less than 6 inches (150 mm) larger in all directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.

- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

SECTION 230900 - BUILDING MANAGEMENT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building Management System (BMS), utilizing direct digital controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Work Required Under Other Divisions Related to This Section:
 - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
 - 2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
 - 3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.3 SYSTEM DESCRIPTION

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over a LonTalk open protocol bus. All controllers on the LonTalk bus shall be LonMark certified.
 - 1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework.
 - 2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
 - 3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
 - 4. All control devices, including configurable and fully programmable controllers, furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools shall not be acceptable.
 - 5. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
 - 6. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus NiagaraAX or Niagara 4 Framework server.
 - 7. A laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics shall be included.
 - 8. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
 - 9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"and "accept.wb.in=*"and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.

10. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
11. All JACE's provided as part of this project shall be the appropriate JACE-8000 model licensed with all necessary drivers.
12. Approved Manufacturers: Honeywell, TAC I/A Series, Distech
13. Approved Installation Contractors: Engineered Control Solutions, Schneider Electric CMS Controls

1.4 SPECIFICATION NOMENCLATURE

- A. Acronyms used in this specification are as follows:
1. Actuator: Control device that opens or closes valve or damper in response to control signal.
 2. AI: Analog Input.
 3. AO: Analog Output.
 4. Analog: Continuously variable state over stated range of values.
 5. BMS: Building Management System.
 6. DDC: Direct Digital Control.
 7. Discrete: Binary or digital state.
 8. DI: Discrete Input.
 9. DO: Discrete Output.
 10. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
 11. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
 12. GUI: Graphical User Interface.
 13. HVAC: Heating, Ventilating and Air Conditioning.
 14. IDC: Interoperable Digital Controller.
 15. ILC: Interoperable Lon Controller.
 16. LAN: Local Area Network.
 17. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
 18. Motorized: Control device with actuator.
 19. NAC: Network Area Controller.
 20. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
 21. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
 22. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
 23. Operator: Same as actuator.
 24. PC: Personal Computer.
 25. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
 26. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
 27. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
 28. PICS: BACnet Product Interoperability Compliance Statement.
 29. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).

- 30. Point: Analog or discrete instrument with addressable database value.
- 31. WAN: Wide Area Network.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.
- D. Shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.
- E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.
- F. Upon completion of the work, provide 3 complete sets of 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and one electronic copy.
- G. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

1.6 QUALITY ASSURANCE

- A. The Control System Contractor shall have a full service DDC office within 50 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. The Control System Contractor shall be staffed with a minimum of ten (10) Niagara 4 certified software engineers and/or technicians. The Control System Contractor shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.
- B. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 10 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop. Control panels shall be assembled such that all necessary I/O points are pre-wired to terminal blocks. Wire ducts shall be installed within the panel as needed to accommodate field wiring.
- C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control

systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.7 SOFTWARE OWNERSHIP

- A. The Owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.9 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.10 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 GENERAL

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.
- B. The installed system shall provide secure strong password access to all features, functions and data contained in the overall BMS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing the LonWorks technology communication protocol in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or

browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 BAS SERVER HARDWARE (Provided by Owner)

- A. Minimum Computer Configuration (Hardware Independent).
 - 1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
 - 2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.
 - 3. Memory: 8 GB or more.
 - 4. Hard Drive: 80 GB minimum, more recommended depending on archiving requirements.
 - 5. Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
 - 6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
 - 7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e. T1, ADSL, cable modem).
- B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.4 SYSTEM NETWORK CONTROLLER (SNC)

- A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- B. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
- C. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication

protocol for peer-to-peer communications between SNC's is not allowed.

- E. The SNC shall employ a device count capacity license model that supports expansion capabilities.
- F. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
 - 1. BACnet
 - 2. Lon
 - 3. MODBUS
 - 4. SNMP
 - 5. KNX
- G. The SNC shall be capable of executing application control programs to provide:
 - 1. Calendar functions.
 - 2. Scheduling.
 - 3. Trending.
 - 4. Alarm monitoring and routing.
 - 5. Time synchronization.
 - 6. Integration of LonWorks, BACnet, and MODBUS controller data.
 - 7. Network management functions for all SNC, PEC and ASC based devices.
- H. The SNC shall provide the following hardware features as a minimum:
 - 1. Two 10/100 Mbps Ethernet ports.
 - 2. Two Isolated RS-485 ports with biasing switches.
 - 3. 1 GB RAM
 - 4. 4 GB Flash Total Storage / 2 GB User Storage
 - 5. Wi-Fi (Client or WAP)
 - 6. USB Flash Drive
 - 7. High Speed Field Bus Expansion
 - 8. -20-60°C Ambient Operating Temperature
 - 9. Integrated 24 VAC/DC Global Power Supply
 - 10. MicroSD Memory Card Employing Encrypted Safe Boot Technology
- I. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- J. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- K. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
 - 1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 - 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 - 3. The following shall be recorded by the SNC for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).

- c. Acknowledge time, date, and user who issued acknowledgement.
- L. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
- M. The SNC shall support the following security functions.
 - 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 - 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 - 3. Require users to use strong credentials.
 - 4. Data in Motion and Sensitive Data at Rest be encrypted.
 - 5. LDAP and Kerberos integration of access management.
- N. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
 - 1. Metadata: Descriptive tags to define the structure of properties.
 - 2. Tagging: Process to apply metadata to components
 - 3. Tag Dictionary
- O. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AVAV, CVAV, VFD) shall have an associated template file for reuse on future project additions.
- P. The SNC shall be provided with a 1 Year Software Maintenance license. Labor to implement not included.

2.5 BUILDING AUTOMATION SYSTEM CONTROLLERS

- A. HVAC control shall be accomplished using LonMark based devices. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
 - 1. Programmable Equipment Controllers - a controller designed for more complex sequences of operations such as built up AHU's, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. The PECs are to allow for the flexibility of custom control programming to meet the needed sequences of operation. PEC's shall be selected based upon I/O requirements. Additional I/O may be added via expansion modules.
 - a. All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - c. PEC's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC or relay).
 - d.
 - 2. Configurable Constant Volume AHU Controller (CVAHU) - the configurable constant volume AHU controller shall be designed specifically for single zone unitary AHU control –temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: unitary air handling units, fan coil units, blower coil units, unit ventilators, and heat pumps.

- a. The CVAHU controller shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the CVAHU controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
- b. The CVAHU controller shall provide LED indication of communication and controller performance to the technician, without cover removal.
- c. CVAHU controllers shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).

2.6 OTHER CONTROL SYSTEM HARDWARE

- A. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range.
- B. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.
- C. Lon Bus Surge Protectors: A Lon Bus Surge Protector, DITEK model # DTK-2MHL P24BWB or equivalent shall be installed on the lon bus when it leaves and enters a building.
- D. Ethernet Port Surge Protector: An Ethernet Surge protector shall be installed similar to the Honeywell 14507678-004 or comparable.
- E. Electric Meter: Digital Electric Meter with Modbus communication. Unit shall display and communicate totalized kWh, voltage, amps, kW

2.7 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Windows operating systems.
- C. The BAS server software shall support at least the following server platforms (Windows 7, 8.1, Server 12). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.

- D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
 - 1. Trending.
 - 2. Scheduling.
 - 3. Electrical demand limiting.
 - 4. Duty Cycling.
 - 5. Downloading Memory to field devices.
 - 6. Real time 'live' Graphic Programs.
 - 7. Tree Navigation.
 - 8. Parameter change of properties.
 - 9. Set point adjustments.
 - 10. Alarm / event information.
 - 11. Configuration of operators.
 - 12. Execution of global commands.
 - 13. Add, delete, and modify graphics and displayed data.
- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
 - 1. Server Software, Database and Web Browser Graphical User Interface.
 - 2. 5 Year Software Maintenance license. Labor to implement not included.
 - 3. Embedded System Configuration Utilities for future modifications to the system and controllers.
 - 4. Embedded Graphical Programming Tools.
 - 5. Embedded Direct Digital Control software.
 - 6. Embedded Application Software.
- F. BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.
- G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
 - 1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
 - 2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.8 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name

and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.

- C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
 - 1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
 - 2. Groups View shall display Scheduled Groups and custom reports.
 - 3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
 - 1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
 - 2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
 - 3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
 - 4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
 - 5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
 - 6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
 - 7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
 - 8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
 - 9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
 - 1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.
 - 2. General Graphic: General area maps shall show locations of controlled buildings in

- relation to local landmarks.
3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
 4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. .
 5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
 - a. Each piece of equipment monitored or controlled including each terminal unit.
 - b. Each building.
 - c. Each floor and zone controlled.
- F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day ' Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the ' Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
 - a. Types of schedule shall be Normal, Holiday or Override.
 - b. A specific date.
 - c. A range of dates.
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
 - e. Wildcard (example, allow combinations like second Tuesday of every month).
 2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.
 4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
 5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal

- schedule for conference room).
6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an 'Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
 2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
 3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
 4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
 5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
 6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A 'network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
 7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
 8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
 9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
 - a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
 - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to

- append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
- d. Write Property: The write property reporting action updates a property value in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
- H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
- 1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
 - 2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 - 3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 - 4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
 - 5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
 - 6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
 - 7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
- I. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:
- 1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
 - b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
 - 2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC

Role) to different areas of the system.

2.9 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
 - 1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
 - 2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
 - 3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
 - 4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
 - 5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
 - 6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
 - 7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
 - 8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
 - 9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
 - 10. Live Graphical Programs: The Graphic Programming software shall support a 'live'

mode, where all input/output data, calculated data and set points shall be displayed in a 'live' real-time mode.

2.10 LONWORKS NETWORK MANAGEMENT

- A. Systems requiring the use of third-party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.
- D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Site Network Controller (SNC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times and within the control system shall not be accepted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to

function and system served with permanently engraved phenolic labels.

3.4 WIRING

- A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. Incorporate electrical noise suppression techniques in relay control circuits.
- E. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- G. Use manufacturer-specified wire for all network connections.
- H. Use approved optical isolation and lightning protection when penetrating building envelope.
- I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.5 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.6 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Contractor shall provide 8 total hours of comprehensive training in

multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the last class is to be in the last month of 1-year warranty period.

3.7 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a 1 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage.
- D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.
- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.8 WARRANTY ACCESS

- A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.9 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
 - 1. As-built control drawings for all equipment.
 - 2. As-built Network Communications Diagram.
 - 3. General description and specifications for all components.
 - 4. Completed Performance Verification sheets.
 - 5. Completed Controller Checkout/Calibration Sheets.

3.10 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

END OF SECTION

SECTION 238126 - SPLIT-SYSTEM AIR CONDITIONING AND HEAT PUMPS UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes ducted and non-ducted split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system units to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set for each air-handling unit.
 - 2. Gaskets: One set for each access door.
 - 3. Fan Belts: One set for each air-handling unit fan.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."

- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 3.
- B. Coordinate sizes and locations of equipment supports, and building penetrations with equipment provided.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 1. Warranty Period:
 - a. For Compressor: Four years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Daikin.
 2. Mitsubishi.
 3. Panasonic.
 4. Samsung.
 5. SANYO North America Corporation; SANYO Fisher Company.

2.2 INDOOR UNITS

- A. Wall-Mounted, Evaporator-Fan Components:
 1. Cabinet: With removable panels and discharge drain pans with drain connection.
 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with AHRI 206/110.
 3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
 4. Fan: Direct drive, centrifugal.

5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Enclosure Type: Totally enclosed, fan cooled.
 - c. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:
 - a. Fabricated with slope in at least two planes to collect condensate from cooling coils and to direct water toward drain connection.
 - b. Single-wall metal or corrosion resistance material or double-wall metal sheet with space between walls filled with foam insulation and moisture-tight seal.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow.
8. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access.
 - b. Disposable Panel Filters:
 - 1) Factory-fabricated.
 - 2) Thickness: 1 inch.
 - 3) MERV 8.

2.3 OUTDOOR UNITS

- A. Air-Cooled, Compressor-Condenser Components:
 1. Casing: With hinged or removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
 2. Compressor: Mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.

4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: As indicated on drawings.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated with flared fittings at both ends.

2.5 CAPACITIES AND CHARACTERISTICS

- A. As indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install compressor-condenser components on manufacturer's supports.
- D. Equipment Mounting:
 1. Install floor and ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 3.
- E. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Drain Pan Operational Test: After installation is complete, if requested, demonstrate to Commissioning agent drain pan function, including but not limited to, complete drainage.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

END OF SECTION 238126

SECTION 260250 – DIVISION OF WORK

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section delineates the division of work between Divisions 21, 22, 23, 26, and 28.
 - 1. Requirements for wiring, materials, methods, and components shall be per Division 26 specifications.
 - 2. Individual motor starters, controls, relays, contactors, and switches (other than disconnects fed from a service transformer), control power transformers, and variable frequency drives (VFD) for mechanical equipment shall be furnished under Division 23, and for plumbing equipment shall be furnished under Division 22, and installed under Division 26 except where they are specified under and identified to be installed by Division 26. Motor-rated toggle switches shall be furnished under Division 23 or Division 22 as applicable and installed under Division 26 and sized in accordance with equipment nameplate data. Separate ground wire sized per NEC shall be provided. Temperature and low voltage controls are to be installed under Division 23, or as applicable under Division 22. Power wiring is to be furnished and installed under Division 26.
 - 3. Disconnect switches for equipment fed directly from a service transformer shall be furnished and installed under Division 26.
 - 4. Wiring and raceway shall be provided under Division 26 up to a termination point consisting of a starter, control power transformer, VFD, motor-rated toggle switch, or disconnect switch. Line side terminations shall be provided under Division 26. Branch circuit wiring and raceway from the termination point to the mechanical equipment, including final connections, shall be provided under Division 23.
 - 5. An additional disconnect switch, furnished under Division 23 and installed under Division 26, shall be required "within sight" of the equipment/motor per Code if the upstream disconnect switch, starter, or VFD is remotely located or not "within sight".
 - 6. Temperature and low voltage controls shall be installed under Division 23. Relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aqua-stats, freeze-stats, line and low voltage thermostats, thermals, remote selector switches, remote push-button stations, emergency break-glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 23 shall be furnished, installed, and wired under Division 23.
 - 7. Unless otherwise indicated, control power transformers and wiring downstream of transformers required for Division 23 or Division 22 controls, instrumentation, motor actuators, and for plumbing fixtures shall be furnished and installed under Division 23 or Division 22 as applicable.
 - 8. Duct mounted smoke detectors including detectors used for control of combination fire/smoke dampers shall be furnished and wired by Division 28, installed by Division 23. Fire alarm ERV shutdown circuits shall be wired from the fire alarm control unit to a termination point adjacent to the ERV controls, under Division 28. ERV control wiring from the termination point to the equipment shall be under Division 23.
 - 9. Smoke Damper and Combination Fire and Smoke Dampers:

- a. Control power transformers and associated enclosures required for the operation and position monitoring of smoke dampers or combination fire and smoke dampers shall be furnished and installed under Division 23.
 - b. Branch circuit wiring and raceway to the primary side of control power transformers shall be furnished, installed, and terminated under Division 26.
 - c. Wiring and raceway on the secondary side of control power transformers throughout the remaining portion of the damper wiring assembly, including but not limited to, wiring required to connect damper actuators, position indicator switches and remote test pushbuttons shall be furnished, installed, and terminated under Division 23, except terminations at fire alarm control relays shall be under Division 28.
10. Sprinkler flow and tamper switches shall be furnished and installed under Division 21 and wired under Division 28.

END OF SECTION 260250

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Grout.
 - 3. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each product indicated.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.
- B. Work shall be in accordance with the 2017 Edition of the National Electrical Code and State and Local Codes.

1.6 INSPECTIONS

- A. The Contractor shall be responsible for contacting the North Carolina State Construction Office to schedule required inspections including rough-in, above ceiling and final inspections for weekdays only, specifically Monday through Friday.

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Mounting heights shall be as indicated on Contract Drawings. If contradictory mounting heights are indicated or if mounting heights are not indicated, notify the Architect immediately and do not proceed with installation until the discrepancy is resolved.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. Low-voltage: Electrical power distribution system voltages rated 1000 volts and less.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member Company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

- B. Southwire Company
- C. General Cable Technologies
- D. Encore Wire
- E. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website..
 - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- F. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with for stranded conductors.
- G. Conductor Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- H. VFC Cable (Type TC-ER): For connection between VFC output and motor connection.
 - 1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped aluminum/polyester/aluminum shield with 25% minimum overlap plus tinned copper braid with 85 percent coverage and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website..
- B. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: Two hole with long barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Power and lighting circuit's minimum conductor size shall be #12 AWG, and maximum conductor size allowed shall be 500 Kcmil.
- D. Full size neutral conductor shall be provided for each service panel and sub-panel. Individual neutral wire shall be provided for each branch circuit feeding loads.
- E. VFC Output Circuits Cable: Extra-flexible stranded for all sizes, Type TC-ER.
- F. Power-Limited Fire Alarm and Control: Provide stranded copper conductors.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- H. Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.

- f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 3. Initial Infrared Scanning: After Final Acceptance, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Final Acceptance.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
- 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Grounding and bonding systems and equipment.
- B. See Electrical Specification Section 260553 "Identification of Electrical Systems" for grounding conductor color coding and identification.
- C. Section includes grounding and bonding systems and equipment plus the following special applications:
 - 1. Foundation steel electrodes.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Grounding arrangements and connections for separately derived systems.
 - 4. Grounding for sensitive electronic equipment.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
 - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member Company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus Bar: Dimensions and hole configuration shall be per Contract Drawings. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Insulators shall be Lexan or PVC and impulse tested at 5000 V.

2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- E. Conduit Hubs: Mechanical type, terminal with threaded hub.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 3/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Bus Bar: Install in electrical equipment rooms, in telephone equipment rooms, and elsewhere as indicated on Contract Drawings.
 - 1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits. A green grounding conductor, properly sized per NEC Table 250-122, shall be run in all raceways.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.

3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Boxes with concentric, eccentric or oversized knockouts shall be provided with bonding bushing and jumpers. The jumper shall be sized per NEC 250 and lugged to the box.
- F. Bond the aboveground portion of the gas piping system upstream from equipment shutoff valve to the building electrical service ground. The bonding jumper shall be sized per NEC 250.
- G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA -607-B.
1. Refer to Contract Drawings for grounding requirements between ground bus bars in telecommunications rooms.
 2. Refer to Contract Drawings for dimensions and required configuration for ground bus bars in telecommunications rooms.
 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal using No. 6 AWG minimum, green, insulated grounding conductor.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 2. For grounding electrode system, install at least three rods spaced at least two-rod lengths from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Conduits Entering Telecommunications Rooms: Metallic conduits entering telecommunications rooms shall be bonded to telecommunications ground bar within that room.

3.4 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections.

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Panelboards Serving Electronic Equipment: 3 ohms.
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in latest versions of NECA 1, NECA 101, and NECA 120.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.

- 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
-
2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 5. Toggle Bolts: All-steel springhead type.
 6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 5. To Light Steel: Sheet metal screws.
 6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, and other devices on slotted-channel racks attached to substrate by means that meet anchorage requirements.
 7. To interior side of exterior walls: Space off wall surface a minimum of 1/4 -inch using clamps or strut.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- F. Powder actuated fasteners are not allowed.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. NBR: Acrylonitrile-butadiene rubber.
- F. RNC: Rigid nonmetallic conduit.
- G. PVC: Polyvinyl chloride
- H. GRC: Galvanized rigid steel conduit

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. Manhattan/CDT/Cole-Flex.
 - 7. Maverick Tube Corporation.
 - 8. O-Z Gedney; a unit of General Signal.
 - 9. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel and comply with UL 1.
- E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Fittings for EMT: Steel, compression type.
 - 2. Expansion Fittings: Steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- G. Joint Compound for Rigid Steel Conduit : Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, except use NEMA 250, Type 4 in damp or wet locations.

- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet Division.
 - 10. Spring City Electrical Manufacturing Company.
 - 11. Thomas & Betts Corporation.
 - 12. Walker Systems, Inc.; Wiremold Company (The).
 - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1, 2-1/8 deep unless otherwise noted.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- G. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

2.4 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.5 SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: Galvanized Rigid steel conduit (GRC) .
 - 2. Concealed Conduit, Aboveground: Galvanized Rigid steel conduit.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: Galvanized steel EMT protected by corrosion protection and approved as suitable for the condition.
 - 2. Exposed and Subject to Severe Physical Damage: Galvanized Rigid steel conduit where installed within 8 feet of finished floor or where otherwise noted on the Contract Drawings.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT unless otherwise noted.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 5. Damp or Wet Locations: Galvanized Rigid steel conduit .
 - 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 in damp or wet locations.
- C. Minimum Raceway Size for Interior Applications: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which a maximum of two 90-degree bends (or equivalent) are allowed.

- G. Install raceway in maximum lengths of 100 feet between pull boxes.
- H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change to rigid steel conduit before rising above the floor.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- M. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 - 2. Raceway bends shall be made using factory-manufactured sweeps that comply with ANSI/TIA/EIA569-A. Minimum bend radius for bends shall be 10-times internal diameter of raceway.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
 - 4. Install plastic bushings at ends of raceways prior to pulling cable.
- N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where an underground service raceway enters a building or structure.
 - 2. Where otherwise required by NFPA 70.
- O. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.

- c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- P. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations.
- Q. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- R. Set metal floor boxes level and flush with finished floor surface.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 3 inches above finished floor level unless otherwise noted on Contract Drawings.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.4 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.6 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Final Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
 - 2. Rigid nonmetallic duct.
 - 3. Duct accessories.
 - 4. Polymer concrete handholes and boxes with polymer concrete cover.

1.3 DEFINITIONS

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
 - 1. Two or more ducts installed in parallel, with or without additional casing materials.
 - 2. Multiple duct banks.
- D. GRC: Galvanized rigid (steel) conduit.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include duct-bank materials, including spacers and miscellaneous components.
 - 2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Include accessories for handholes.
 - 4. Include underground-line warning tape.
- B. Shop Drawings:

1. Factory-Fabricated Handholes:

- a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
- b. Include duct entry provisions, including locations and duct sizes.
- c. Include cover design.
- d. Include grounding details.

1.5 INFORMATIONAL SUBMITTALS

- A. Duct and Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Electrical Components, Devices and Assemblies: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than 14 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.

2.2 RIGID NONMETALLIC DUCT

- A. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CANTEX INC.
 - 2. Carlon; a brand of Thomas & Betts Corporation.
 - 3. Charlotte Pipe.

2.3 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. CANTEX INC.
 - b. Carlon; a brand of Thams & Betts Corporation.
 - c. Underground Devices, Inc.
- B. Underground-Line Warning Tape:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Brady Corporation.
 - b. Ideal Industries, Inc.
 - c. LEM Products Inc.
 - 2. Tape:
 - a. Recommend by manufacturer for the method of installation and suitable to identify and locate underground election and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 3. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE."
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE."

4. Underground Detectable Tape:

- a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
- b. Width: 6 inches.
- c. Overall Thickness: 5 mils.
- d. Foil Core Thickness: 0.35 mil (0.00889 m).
- e. Weight: 34 lb/1000 sq. ft. (16.6 kg/100 sq. m).
- f. Tensile according to ASTM D 882: 300 lbf (1334 N) and 12,500 psi (86.1 MPa).

2.4 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Armorcast Products Company.
 2. Carson Industries LLC.
 3. CDR Systems Corporation.
 4. Hubbell Power Systems; Lenoir City Division.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Green.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering:
 1. "ELECTRIC" for handholes containing conductors with system voltages greater than 50 VAC, "TELEPHONE" for handholes containing telecommunications cabling.
 2. Tier level number, indicating that the unit complies with the structural load test for that tier according to SCTE 77.
- I. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- J. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Feeders 600 V and Less: Type EPC-40-PVC RNC, concrete-encased unless otherwise indicated.
- B. Duct for Electrical Branch Circuits: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.
- C. Underground Ducts Routed Beneath or Crossing Driveways and Roadways: Type EPC-80-PVC RNC, encased in reinforced concrete unless otherwise indicated.
- D. Encased raceways shall be of type approved by NEC as, "Suitable for Concrete Encasement".
- E. Stub-ups: Concrete-encased GRC.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - 2. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
 - 3. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

- B. Restoration: Replace area after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

3.5 DUCT AND DUCT-BANK INSTALLATION

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Slope: Pitch duct a minimum slope of 4-inches in 100 feet down toward handholes and away from buildings and equipment.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
 - 1. Duct shall have maximum of two 90-degree bends or the total of all bends shall be no more 180 degrees between pull points, unless otherwise shown on Contract Drawings.
- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- G. End Bell Entrances to Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch duct, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell, without reducing duct slope and without forming a trap in the line.
 - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.

- H. Terminator Entrances to Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches o.c. for 4-inch duct and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to terminator spacing 10 feet from the terminator, without reducing duct line slope and without forming a trap in the line.
 - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to handhole. Install an expansion fitting near the center of all straight line duct with calculated expansion of more than 3/4 inch.
- I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- K. Pulling Cord: Install 200-lbf-test nylon cord in empty ducts.
- L. Concrete-Encased Ducts and Duct Bank:
 - 1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches in nominal diameter.
 - 2. Width: Excavate trench 12 inches wider than duct on each side.
 - 3. Width: Excavate trench 3 inches wider than duct on each side.
 - 4. Burial Depth:
 - a. Ducts carrying circuits with voltages 600V or less in areas not subject to deliberate traffic: 18-inches minimum below finished grade measured to top of concrete encasement.
 - b. Ducts in areas subject to deliberate traffic: 30-inches minimum below finished grade measured to top of concrete encasement.
 - c. Ducts carrying circuits with voltages greater than 600V: 30-inches minimum below finished grade measured to top of concrete encasement.
 - 5. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
 - 6. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 - 7. Minimum Space between Duct: 3 inches between edge of duct and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and communications ducts.
 - 8. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
 - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

- b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches above finished grade and minimum 3 inches from conduit side to edge of slab.
 - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches above finished floor and no less than 3 inches from conduit side to edge of slab.
 - 9. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 - 10. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 - 11. Concrete Cover: Install a minimum of 4 inches of concrete cover between edge of duct to exterior envelope wall, 3.5 inches between duct of like services, and 4 inches between power and communications ducts.
 - 12. Concreting Sequence: Pour each run of envelope between terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
 - 13. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.
- M. Underground-Line Warning Tape: Bury conducting underground line warning tape no less than 12 inches above all concrete-encased duct and duct banks and approximately 12 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.
- 3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE
- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.

- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below frost line, 18 inches below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
 - 3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION 260543

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Sleeves for raceway penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:

- 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

- C. Sleeves for Rectangular Openings:

- 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.

- b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. HOLDRITE.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- D. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible boot-type flashing units applied in coordination with roofing work.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- F. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- F. Electrical Components, Devices and Assemblies: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.2 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 10 by 14 inches. Larger sizes where required to accommodate specified text.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES". For Equipment Operating at 208Y/120 V and 42 inches for Equipment Operating at 480Y/277V

2.3 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Minimum letter height shall be 1/2 inch.

B. Colors for Equipment Nameplates:

1. Equipment operating at 120/208V: Blue surface with white core.
2. Equipment operating at 277/480V: Black surface with white core.
3. Fire Alarm System Components: Bright red surface with white core.
4. Security System Components: Dark burgundy surface with white core.
5. Emergency System Components (NEC Article 700): Green surface with white core.
6. Telephone System Components: Orange surface with white core.
7. Data System Components: Brown surface with white core.

2.5 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location exterior or interior.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Colors for Raceways Carrying Circuits Associated with the Fire Alarm System:
 - 1. Raceways and boxes carrying conductors serving fire alarm system components shall be painted red along entire length of exposed sections.
- B. Accessible Raceways and Boxes within Buildings: Identify raceways and boxes for each system identified in section titled, "EQUIPMENT IDENTIFICATION LABELS". Paint colors shall match surface colors specified in same section.
 - 1. Raceways: Paint one foot of exposed raceway beginning at point where raceways terminate at boxes.
 - 2. Pull and Junction Boxes: Paint boxes and box covers in their entirety.
 - 3. Conductors inside pull and junction boxes: Identify circuit number for each conductor using self-adhesive vinyl labels. Labels shall completely encircle conductors. Label each conductor inside box.
 - 4. Pull and Junction Box Covers: Identify circuit number using permanent black marker. Print legibly.
 - 5. Spare Raceways and Raceways with Conductors Installed for Future Use: Identify termination point consisting of panelboard and circuit number. Affix plastic tag with identification information to end of raceway using wire.
- C. Power-Circuit Conductor Identification, 600 V or Less:
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - 2. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied to conductor insulation for conductors #6 AWG and smaller.
 - b. Color shall be factory or field applied for conductors larger than #6 AWG.
 - c. Color shall be factory applied to conductor insulation for neutral conductors.

- d. Color shall be factory applied to conductor insulation for ground conductors except where bare conductors are specified.
 - e. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral: White.
 - 5) Ground: Green
 - f. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral: Natural Gray.
 - 5) Ground: Green
 - g. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
- 1. Install underground-line warning tape for cables in raceway and encased in concrete ductbanks.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Metal-backed, butyrate warning signs.
- 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Controls with external control power connections.
 - b. Lighting Contactors.

- H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer.
- J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

- a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
- b. Panelboards and Disconnect Switches: Engraved, laminated acrylic or melamine label. Provide two lines of text on 2-inch high label for the following:
 - 1) Top Line: 1/2-inch high letters indicating panel name.
 - 2) Bottom Line: 1/4-inch high letters indicating, "PANEL FED FROM XXX IN RM. YYY" where "XXX" indicates panel from which device is fed and "YYY" indicates room number of panel from which device is fed.
- c. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
- d. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- e. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

- a. Panelboards.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- e. Emergency system boxes and enclosures.
- f. Enclosed switches.
- g. Enclosed circuit breakers.
- h. Enclosed controllers.
- i. Contactors.
- j. Remote-controlled switches, dimmer modules, and control devices.
- k. Monitoring and control equipment.
- l. Fire Alarm System Components.

END OF SECTION 260553

SECTION 260573 – POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes computer-based, fault-current, overcurrent protective device coordination and arc flash evaluation studies for equipment and overcurrent protective devices equipped with adjustable trip settings. Protective devices shall be set based on results of the protective device coordination study. Selective coordination as required by National Electrical Code (NEC) shall be provided. Emergency load branch circuit overcurrent devices shall be selectively coordinated with, both normal and central lighting inverter feeders, overcurrent devices. Provide overcurrent devices accordingly.

1.3 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates:
 - 1. For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
 - 2. For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.
- C. Qualification Data: Specialist performing coordination-study, arc-flash study, and short-circuit study.
- D. Other Action Submittals: The following submittals shall be made immediately after the approval process for system protective devices has been completed. Submittals shall be in digital form.
 - 1. Provide table, in Microsoft Excel format, indicating installed conductor lengths for each panelboard feeder and service entrance conductor set.
 - 2. Short-circuit study and Equipment Evaluation Reports.
 - 3. Arc-flash study results indicating incident energy levels at each system bus.
 - 4. Coordination-Study Report.
 - 5. A schedule of adjustable devices indicating proper dial and tap settings to achieve the plotted characteristics shall be submitted with the study.
 - 6. Short-circuit study, overcurrent protective device coordination study, and arc-flash study shall be submitted in the form of 1 set of original reproducible, 3 copies thereof, and an electronic copy in PDF format.
 - 7. Submit overcurrent protective device coordination study, short-circuit study, and arc-flash evaluation study concurrently, prepared in accordance with requirements herein.
 - 8. Input data for arc-flash study, including completed computer program input data sheets.

1.4 QUALITY ASSURANCE

- A. Studies shall be performed by panelboard manufacturer at the time of final submittal of the panelboard submittals. Studies shall be performed using computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Qualifications for Specialist Preforming Power System Studies: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices. Studies shall be prepared under the supervision and approval of a licensed professional electrical engineer skilled in performing and interpreting power system studies. Do not release the panelboard and central lighting inverter for construction until the study is submitted and approved.
- C. Field Adjusting Personnel Qualifications: Personnel with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- D. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- E. Comply with IEEE 399.
- F. Comply with IEEE 551.
- G. Comply with IEEE 1584 and NFPA 70E.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Computer Software Developers: Subject to compliance with requirements, utilize software by one of the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.
 - 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Comply with IEEE 242.
- C. Comply with IEEE 1584.
- D. Comply with NFPA 70E.

- E. Comply with IEEE 399 and IEEE 551.
- F. Analytical features of computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- G. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements, short-circuit current interrupting ratings and other conditions affecting performance.
 - 1. Proceed with power system studies only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to studies shall not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support power studies:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in power system studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical characteristics for site distribution equipment provided for electrical site. Coordinate with University electrical representative to obtain utility information.
 - 3. Impedance of utility transformer.
 - 4. Electrical Distribution System Single-Line Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - e. Motor horsepower and code letter designation according to NEMA MG 1.
 - f. Central Lighting Inverter KVA rating.
 - g. Short-circuit available at each bus in the system.
 - 5. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.

- b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
- c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
- d. Ratings, types, and settings of utility transformer's overcurrent protective devices.
- e. Source impedance data, including electric utility system and motor fault contribution characteristics.
- f. Time-current-characteristic curves of devices indicated to be coordinated. Different colors shall be used for each curve. Curves shall be plotted on full scale log-log graph paper for overcurrent devices, starting characteristics of motors, transformer full load current, magnetizing current and withstand parameter curves, cable damage curves, central lighting inverter fault current and decrement curves, and motor starting characteristics and damage points. Curves for adjustable devices shall be shown adjusted to afford maximum coordination with upstream and downstream devices, including devices provided by the electric utility system, and minimize arc flash hazard levels.
- g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- i. Panelboards ampacity, bus withstand ratings and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. Distribution panelboard.
 - 2. Branch circuit panelboard.
 - 3. Central Lighting Inverter.
- B. Study electrical distribution system from normal and emergency power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. IEEE C57.12.00.
 - 2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 3. Low-Voltage Fuses: IEEE C37.46.

E. Fault-Current Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. The sources of fault current for the study shall include the utility's single-line-to-ground fault and three-phase bolted fault with X/R ratio for each fault component and fault current contributions from central lighting inverter.
3. Where the short circuit study indicates a fault level different from that indicated on the Drawings, describe the variance and include back-up information and calculations. Coordinate required short circuit interrupting ratings, based on study results, with distribution equipment manufacturer.
4. Include Executive Summary.

F. Equipment Evaluation Report:

1. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
2. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program to demonstrate selective coordination for emergency standby system components (NEC Article 700). Prepare a written report using results of study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 141 and IEEE 242 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current.
2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

- E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve coordination. Graphically illustrate that adequate time separation exists between devices installed in series. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - e. No damage, melting, and clearing curves for fuses.
 - f. Cable damage curves.
 - g. Transformer inrush points.
 - h. Maximum fault-current cutoff point.
 3. Include Executive Summary.
- F. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH EVALUATION STUDY

- A. General: Arc flash evaluation study shall be prepared in accordance with NFPA 70E and IEEE 1584. The study shall determine the flash protection boundary and personal protective equipment required for personnel within the flash protection boundary and shall include the creation of arc flash hazard warning labels. The study results shall be summarized in a final report and included with the short circuit and overcurrent protective device coordination study. Do not energize electrical equipment until the study is submitted and approved and the arc flash labels are affixed on the equipment.
1. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (panelboards) where work could be performed on energized parts.
 2. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2 .
 3. Incident Energy and Flash Protection Boundary Calculations shall include:
 - a. Arcing fault magnitude.
 - b. Device clearing time.
 - c. Duration of arc.

- d. Arc flash boundary.
 - e. Working distance.
 - f. Incident energy.
 - g. Hazard risk category.
- 4. Arc flash labels shall have the wording "WARNING, ARC FLASH HAZARD" and shall include the following information:
 - a. Orange Header Color: For equipment with available incident energy levels below 40 cal/cm².
 - b. Red Header Color: For equipment with available incident energy levels 40 cal/cm² and above.
 - c. Location designation.
 - d. Nominal voltage.
 - e. Flash protection boundary.
 - f. Incident energy.
 - g. Working distance.
 - h. Engineering report number, revision number and issue date.
- 5. Include Executive Summary.
- B. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 FIELD ADJUSTMENT

- A. Adjust protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Owner in writing of any required major equipment modifications.

3.7 DEMONSTRATION

- A. Train Owner's operating and maintenance personnel in the use of study results.
- B. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor photoelectric switches.
 - 3. Daylight harvesting switching controls.
 - 4. Indoor occupancy sensors.
 - 5. Lighting contactors.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 DIGITAL TIME SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Area Lighting Research, Inc.; Tyco Electronics.
 - 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 3. Intermatic, Inc.
 - 4. Leviton Mfg. Company Inc.
 - 5. Lightolier Controls; a Genlyte Company.
 - 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 7. Paragon Electric Co.; Invensys Climate Controls.
 - 8. Square D; Schneider Electric.
 - 9. TORK.
 - 10. Touch-Plate, Inc.
 - 11. Watt Stopper (The).
- B. Digital Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: SPDT.
 - 2. Contact Rating: 20-A ballast load, voltage rating as required.
 - 3. Programs: Two channels; each channel shall be individually programmable with 40 on-off operations per week, plus 4 seasonal schedules that modify the basic program, and an annual holiday schedule that overrides the weekly operation on holidays.
 - 4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
 - 5. Astronomic Time: All channels.
 - 6. Battery Backup: For schedules and time clock.
 - 7. Astronomic time dial.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Area Lighting Research, Inc.; Tyco Electronics.
 - 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 3. Intermatic, Inc.
 - 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 5. Novitas, Inc.
 - 6. Paragon Electric Co.; Invensys Climate Controls.
 - 7. Square D; Schneider Electric.
 - 8. TORK.

9. Touch-Plate, Inc.
10. Watt Stopper (The).

B. Description: Solid state, dusk-to dawn type, with SPST dry contacts rated for 1000-VA tungsten or 1800-VA ballast, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A. Device shall be suitable for switching high inrush LED luminaires.

1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
4. Device shall fail in "on" state.
5. Relay contacts: Silver alloy type.
6. Light Sensor: Non-drifting type.
7. Mounting: Stem-and-swivel mount complying with ANSI C136.24. Furnish with mounting accessories as required to direct sensor to the north sky exposure.

2.3 DAYLIGHT-HARVESTING SWITCHING CONTROLS

A. System Description: System operates indoor lighting.

B. Sequence of Operation: As daylight increases, the lights are turned off at a predetermined level. As daylight decreases, the lights are turned on at a predetermined level.

1. Lighting control set point is based on two lighting conditions:
 - a. When no daylight is present.
 - b. When significant daylight is present (target level).
 - c. System programming is done with two hand-held, remote-control tools.

C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Test Mode: User selectable, overriding programmed time delay to allow settings check.
4. Control Load Status: User selectable to confirm that load wiring is correct.
5. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.4 INDOOR OCCUPANCY SENSORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Lighting.
2. Leviton Mfg. Company Inc.
3. Novitas, Inc.
4. Watt Stopper (The).
5. Lutron Electronics, Inc.
6. Clipsal (by Schneider Electric)

- B. Switchbox-Mounted Occupancy Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox, using hardwired connection.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 - 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 - 4. Switch Rating: Not less than 800-VA ballast or LED load at 120 V, 1200-VA ballast or LED load at 277 V.

2.5 LIGHTING CONTACTORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Allen-Bradley/Rockwell Automation.
 - 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 - 3. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 4. GE Industrial Systems; Total Lighting Control.
 - 5. Square D; Schneider Electric.
- B. Description: Electrically operated and mechanically held combination type with non-fused disconnect, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: As indicated on Contract Drawings.
 - 2. Fault Current Withstand Rating: As indicated on Contract Drawings.
 - 3. Enclosure: Comply with NEMA 250.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Final Acceptance, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260923

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Distribution, dry-type transformers rated 600 V and less, with capacities up to 300 kVA. The efficiency of the transformers shall be no less than that required for their KVA rating in compliance with the Department of Energy 2016 efficiency (DOE 2016).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
 - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufactures subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutter Hammer products.

2. General Electric Company.
3. Square D; Schneider Electric.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.
- C. Transformers Rated 15 kVA and Larger: Comply with DOE 2016 energy-efficiency level.
- D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
- E. Coils: Continuous windings without splices except for taps.
 1. Internal Coil Connections: Brazed or pressure type.
 2. Coil Material: Copper.
- F. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.
- G. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated.
 1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
 1. Finish Color: Gray.
- E. Taps for Transformers 3 kVA and Smaller: One 5 percent tap above normal full capacity.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class, Smaller than 30 kVA: 220 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.
- I. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 80-deg C rise above 40-deg C ambient temperature.
- J. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
 - 1. 9 kVA and Less: 40 dBA or less.
 - 2. 30 to 50 kVA: 45 dBA or less.
 - 3. 51 to 150 kVA: 50 dBA or less.
 - 4. 151 to 300 kVA: 55 dBA or less.

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
 - 1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
 - 2. Ratio tests at the rated voltage connections and at all tap connections.
 - 3. Phase relation and polarity tests at the rated voltage connections.
 - 4. No load losses, and excitation current and rated voltage at the rated voltage connections.
 - 5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
 - 6. Applied and induced tensile tests.
 - 7. Regulation and efficiency at rated load and voltage.
 - 8. Insulation Resistance Tests:
 - a. High-voltage to ground.
 - b. Low-voltage to ground.
 - c. High-voltage to low-voltage.
 - 9. Temperature tests.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- B. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
 - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- C. Secure transformer to concrete base according to manufacturer's written instructions.
- D. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- E. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: After Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than fourteen days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.

1.7 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Enclosure types shall be provided as indicated on Contract Drawings.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - 5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover. Directory shall be typed. Handwritten directories are not acceptable.
- B. Incoming Mains Location: Top or bottom as required to facilitate panelboard installation.
- C. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Neutral Bus: Fully Rated.

- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Panelboard Rating: As indicated on Contract Drawings.
- G. Panelboard Short-Circuit Current Rating: As indicated on Contract Drawings, fully rated to interrupt symmetrical short-circuit current.
- H. Panelboards with feed-thru lugs shall not be permitted.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: As indicated on Contract Drawings.
- E. Branch overcurrent protective devices for circuit breaker frame sizes 125 A and smaller: Bolt-on circuit breakers.
- F. Branch overcurrent protective devices for circuit breaker frame sizes larger than 125 A: Bolt-on circuit breakers.
- G. Branch Circuit Breakers: As indicated on Contract Drawings.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

- C. Mains: As indicated on Contract Drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 LOAD CENTERS

- A. Load centers shall not be permitted.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads.
 - d. Handle Padlocking Device: Fixed attachment for locking circuit-breaker handle in on or off position.
 - e. Handle Clamp: Loose attachment for holding circuit-breaker handle in on position.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim at a height above finished floor such that highest operable mechanism is at a maximum height of 6'-6" above finished floor. Unless prohibitive due to physical size of equipment, mounting heights shall be consistent throughout building.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Provide Arc-flash warning stickers affixed to front surface of panelboards located in non-dwelling occupancies. Stickers shall comply with Specification 260573, "Power System Studies Stickers shall be visible without opening panel door. Sticker dimensions shall be 3.5 in. x 5 in. and shall be machine printed using thermal transfer type label of high adhesion polyester.

- C. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- D. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- E. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- F. Label individual branch circuit conductors with circuit number at the point where conductor is terminated at branch circuit breaker. Labels shall be machine printed, white with black numerals.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Final Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Final Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Power System Studies."
- C. Load Balancing: After Final Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed by Owner. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Straight blade receptacles, receptacles with integral GFCI and associated device plates.
 - 2. .
 - 3. Twist-locking receptacles.
 - 4. Cord and plug sets.
 - 5. Toggle switches.
 - 6. Wall plates.
 - 7. .

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.

- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Device Faceplates: Quantity of 2% spare of each type shall be provided to the owner.
 - 2. GFI Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. General Description:
 - 1. Duplex receptacles shall be of the grounding type, arranged for back and side wiring, with separate single or double grounding terminals.
 - 2. Self-grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.
- B. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, DSCC W-C-596G (Fed Spec) and UL 498 and shall be "approved" third-party listed.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with the following:
1. NEMA WD 1, NEMA WD 6, UL 498, UL 943, DSCC W-C-596G and UL 943 Class A.
 2. Devices shall be "approved" third-party listed, Class A, and include indicator light that is lighted when device is tripped.
 3. Duplex receptacles shall be of the grounding type, arranged for back and side wiring, with separate single or double grounding terminals.
 4. Self-grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.
 5. Devices installed in outdoor locations or in damp or wet locations shall be listed as weather resistant type and shall bear the "WR" identifier mark.

2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles: Comply with NEMA WD 1, NEMA WD 6, and UL 498. See Contract Drawings for required voltage, ampere rating and NEMA configuration.

2.5 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Toggle switches shall be of the grounding type, with a hex-head grounding screw, rated 20A, 120/277 volt, A.C. only.
- C. All switches shall have quiet operating mechanisms without the use of mercury switches.
- D. All switches shall be listed by an approved third-party agency, approved for the voltage and amperage indicated.
- E. Switches, 120/277 V, 20 A:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
- b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
- c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
- d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

F. Pilot Light Switches, 20 A:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

2.7 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished and Unfinished Spaces: 0.035-inch- thick, satin-finished 302 stainless steel.
3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof "While-in-use" Covers: NEMA 250, complying with type 3R weather-resistant. Constructed of die-cast aluminum with lockable cover and Extra-Duty Rated. Cover plates shall be "approved" third-party listed as "rain-tight while in use"

2.8 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: To be selected by Architect during product data submittal review.
2. Wiring Devices Connected to Emergency Power System: Green.
3. Wiring Devices Connected to Optional Standby Power System: Brown

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- D. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment and final cleaning of spaces is complete.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 - 5. Use side wiring with binding-head screw terminals. Wrap conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 8. Tighten unused terminal screws on the device.
 - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, reversed ground and neutral, reversed hot and neutral and similar problems. Correct circuit conditions remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600-V ac and less for use in enclosed switches.
 - 2. Spare-fuse cabinets.
- B. Fuses shall be so selected as to provide fully selective system.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Coordination charts and tables and related data.
 - 4. Fuse sizes for elevator feeders and elevator disconnect switches.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Motor Branch Circuits: Class RK5, time delay. Current limiting.
 - 2. Other Branch Circuits: Class RK5, time delay.
 - 3. Control Circuits: Class CC, fast acting.
- B. Fusible Safety Switches: Provide fusible safety switches with withstand ratings of 100KA or 200KA with Class R or Class J rejection fuse block feature.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Non-fusible switches.
 - 3. Molded-case circuit breakers (MCCBs).
 - 4. Enclosures.
- B. Related Sections include the following:
 - 1. Division 26 Section "Fuses."
 - 2. Division 26 Section "Identification of Electrical Systems."

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Comply with indicated maximum dimensions, where indicated on Contract Drawings for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.
- D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Owner no fewer than fourteen days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Owner's written permission.
 4. Comply with NFPA 70E.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Square D; a brand of Schneider Electric.
- B. General duty switches are not acceptable.
- C. Type HD, Heavy Duty, Single Throw, 240-Vac or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Switches shall be third- party listed.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 4. Auxiliary Contact Kit: Where indicated on Contract Drawings, provide with one normally open (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "on" position.
 - 6. Switches shall have non-teasable, positive, quick make-quick break mechanisms.
 - 7. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 8. Switches shall have handles whose positions are easily recognizable in the "on" or "off" position. Padlocks shall be provided for switches located in public areas.
 - 9. Lugs: Mechanical type, suitable for number, size, and conductor material.

10. Switches shall be properly labeled. See Section 260553 "Identification for Electrical Systems."

2.2 NONFUSIBLE SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.
- B. General duty switches are not acceptable.
- C. Type HD, Heavy Duty, Single Throw, 240-Vac or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Switches shall be third- party listed.
- E. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 4. Auxiliary Contact Kit: Where indicated on Contract Drawings, provide with one normally open (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 5. Switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "on" position.
 6. Switches shall have non-teasible, positive, quick make-quick break mechanisms.
 7. Hookstick Handle: Allows use of a hookstick to operate the handle.
 8. Switches shall have handles whose positions are easily recognizable in the "on" or "off" position. For safety reasons, padlock shall be provided for switches located in the public areas.
 9. Lugs: Mechanical type, suitable for number, size, and conductor material.
 10. Switches shall be properly labeled. See Section 260553 "Identification for Electrical Systems."

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I²t response.
- F. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Wash-Down Areas: NEMA 250, Type 4X
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.
- B. Provide Arc-flash warning stickers affixed to front surface of switch and circuit breaker enclosures. Stickers shall comply with Specification 260573, "Power System Studies". Stickers shall be visible without opening panel door. Sticker dimensions shall be 3.5 in. x 5 in. and shall be machine printed using thermal transfer type label of high adhesion polyester.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification (NETA ATS-2013). Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Power System Studies."

The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

END OF SECTION 262816

SECTION 263323.11 - CENTRAL BATTERY EQUIPMENT FOR EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following central battery and power conversion equipment rated 600 V and less for emergency lighting:
 - 1. Interruptible (fast-transfer) central battery equipment.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. IBC: International Building Code.
- C. Interruptible: As used in the Section Text, an off-line, passive-standby or line-interactive, inverter-only unit, with an intentional interruption of power to the load until an internal transfer switch picks up and transfers the load to the unit's inverter and internal battery source on loss of the "normal" source, and then retransfers to the "normal" source when it is restored. Transfer time can be "slow" (up to approximately 1 second) or "fast" (2-4 ms or 40-50 ms, depending on manufacturer).
- D. LED: Light-emitting diode.
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- F. NiCd: Nickel cadmium.
- G. OCPD: Overcurrent protective device.
- H. PC: Personal computer.
- I. PWM: Pulse-width modulated.
- J. TDD: Total demand (harmonic current) distortion (also listed as "THD" in catalog data by manufacturers).
- K. THD (V): Total harmonic voltage demand.

- L. Uninterruptible: As used in the Section Text, an on-line, double-conversion (rectifier/inverter) unit, with no interruption of power to the load on interruption and restoration of the "normal" source.
- M. VRLA: Valve-regulated lead acid.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of central battery equipment unit.
 - 1. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, shipping splits, and furnished options, specialties, and accessories.
- B. Shop Drawings: For each type and rating of central battery equipment unit.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, ventilation requirements, method of field assembly, components, and location and size of each field connection.
 - 3. Include system one-line diagram, internal and interconnecting wiring; and diagrams for power, signal, and control wiring.
 - 4. Include elevation, details, and legends of control and indication displays.
 - 5. Include -circuit current (withstand) rating of unit.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around central battery equipment. Show central battery equipment layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- B. Qualification Data: For Installer and testing agency.
- C. Product Certificates: For each type of central battery equipment.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For central battery equipment to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- a. Manufacturer's written instructions for testing central battery equipment.
- b. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
- c. Manufacturer's written instructions for selecting and setting field-adjustable controls and status and alarm points

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
 1. Fuses: One for every 10 of each type and rating, but no fewer than of each type.
 2. Cabinet Ventilation Filters: One complete set.
 3. Circuit Board: One spare circuit board for each critical circuit.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in fully enclosed vehicles.
- B. Store equipment in spaces having environments controlled within manufacturers' written instructions for ambient temperature and humidity conditions for non-operating equipment.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Less than 32 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
 2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
 3. Humidity: More than 95 percent (condensing).
 4. Altitude: Exceeding 3300 feet.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for central battery equipment, including clearances between central battery equipment and adjacent surfaces and other items.

1.11 COORDINATION

- A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace central battery equipment that fails in materials or workmanship within specified warranty period. Special warranty, applying to batteries only, applies to materials only, on a prorated basis, for period specified.
 - 1. Warranty Period: Include the following warranty periods, from date of Substantial Completion:
 - a. Central Battery Equipment (excluding Batteries): One year.
 - b. Standard VRLA Batteries:
 - 1) Full Warranty: One year.
 - 2) Pro Rata: Ten years.

PART 2 - PRODUCTS

2.1 INTERRUPTIBLE (FAST-TRANSFER) CENTRAL BATTERY EQUIPMENT

- A. Bases of Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Chloride System.
 - 2. Dual-Lite.
 - 3. Crucial Power Products.
- B. General Requirements for Interruptible (Fast-Transfer) Central Battery Equipment:
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. NRTL Compliance: Fabricate and label central battery equipment to comply with UL 924 and UL 1778.
 - 3. Comply with the IBC, NFPA 70, and NFPA 101.
 - 4. Comply with NEMA PE 1.
- C. Performance Requirements:
 - 1. Fast-Transfer Central Battery Equipment: Passive standby (off-line) system. Automatically sense loss of normal ac supply and use a solid-state static switch to transfer load. Transfer in 2-4 ms or less from normal supply to battery-inverter supply.
 - 2. Automatic Operation:
 - a. Normal Conditions: Supply the load with ac power flowing from normal ac power input terminals, bypassing inverter, with battery connected in parallel via rectifier/charger output.

- b. Abnormal Supply Conditions: If normal ac supply deviates from specified voltage, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
- c. If normal power fails, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
- d. If a fault occurs in system when being supplied by inverter and current flows in excess of the overload rating of inverter, inverter automatically protects itself against damage from overloads and short circuits by shutting down.
- e. When normal ac power is restored at input supply terminals of unit, controls automatically retransfer the load back to the normal ac supply, with a momentary loss of power to the load. Rectifier/charger then recharges battery.
- f. If normal power failure is prolonged (more than 90 minutes), integral low-voltage battery protective circuit disconnects battery and prevents battery from damage due to deep discharge.
- g. If battery becomes discharged, and when normal ac supply is again available, rectifier/charger recharges battery. When battery is fully charged, rectifier/charger automatically shifts to float-charge mode.
- h. If battery is disconnected, and normal ac power is available, central battery equipment continues to supply power to the load with no degradation of its regulation of voltage and frequency of output bus.

D. Unit Operating Requirements:

- 1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of central battery equipment input voltage rating.
- 2. Input Frequency Tolerance: Plus or minus 3 percent of central battery equipment frequency rating.
- 3. Synchronizing Slew Rate: 1 Hz per second, maximum.
- 4. Minimum Off-Line Efficiency: 95 percent at 60 Hz, full load.
- 5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or operating condition.
- 6. Ambient Temperature Rating (Other Than Batteries): Not less than 68 deg F and not exceeding 86 deg F.
- 7. Ambient Storage Temperature Rating (Other Than Batteries): Not less than minus 4 deg F and not exceeding 158 deg F.
- 8. Ambient Temperature Rating (Batteries): Not less than 32 deg F and not exceeding 104 deg F.
- 9. Ambient Storage Temperature Rating (Batteries): Not less than 0 deg F and not exceeding 104 deg F.
- 10. Humidity Rating: Less than 95 percent (noncondensing).
- 11. Altitude Rating: Not exceeding 3300 feet.
- 12. Off-Line Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

E. Inverter and Controls Logic: Microprocessor based, isolated from all power circuits; provides complete self-diagnostics, periodic automatic testing and reporting; with alarms.

F. Controls and Indication:

- 1. Status Indication: Door-mounted, labeled LED indicators or digital screen displaying the following conditions:
 - a. Normal power available.

- b. Status of system.
 - c. Battery charging status.
 - d. On battery power.
 - e. System fault.
 - f. External fault.
2. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
- a. Keypad: In addition to required programming and control keys, include the following:
 - 1) Keys for METER, CONTROL, PROGRAM, and CLEAR modes.
 - 2) Security Access: Provide electronic security access to controls through identification and password with at least two levels of access: View only; and view, operate, and service.
 - 3) Control Authority: Supports at least three conditions: Off, local manual control at unit and local automatic control at unit.
 - b. Digital Display: Plain-English language messages on a digital display; provide the following historical logging information and displays:
 - 1) Real-time clock with current time and date.
 - 2) Tests and Events Logs: Record and store up to 25 tests and events.
 - a) Dates.
 - b) Times.
 - c) Durations.
 - d) Output voltage and currents.
 - 3) Alarm Logs: Record and store up to 25 alarms.
 - a) Dates.
 - b) Times.
 - c) Alarm type.
 - 4) Alarm Functions: Digital display mounted flush in unit door and connected to display central battery equipment parameters including, but not limited to, the following:
 - a) High/low battery charge voltage.
 - b) High/low input voltage.
 - c) Battery nearing low-voltage condition.
 - d) Battery low voltage.
 - e) High ambient temperature.
 - f) Inverter fault.
 - g) Output fault.
 - h) Output overload.
3. Remote Signal Interfaces:

- a. Remote Indication Interface: A minimum of one programmable (Form C) dry-circuit relay output(s) (120-V ac, 2 A) for remote indication of the following:
 - 1) Fault or status indication.
 - 2) On bypass.
 - 3) Low battery.
- b. Communications Interface: Factory-installed hardware and software to enable a remote PC to program central battery equipment and monitor and display status and alarms.
 - 1) Communications Ports: RS-485
 - 2) Network Communications Ports: Ethernet and RS-485
 - 3) Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via DDC system for HVAC RS-485 serial networks and Ethernet 10Base-T networks as a native device.

G. Self-Protection and Reliability Features:

- 1. Input transient protection by means of surge suppressors to provide protection against damage from supply voltage surges as defined in IEEE C62.45, Category B and C.
- 2. Integral, programmable, self-diagnostic and self-test circuitry; with alarms and logging.
- 3. Battery deep-discharge and self-discharge protection; with alarms.
- 4. Battery self-test circuitry; with alarms and logging.

H. Integral Input Disconnecting Means and OCPD: Thermal-magnetic circuit breaker, complying with UL 489.

- 1. Integrated Equipment Minimum Short-Circuit Current (Withstand) Rating: 22 kA.

I. Inverter:

- 1. Description: Solid-state, high-frequency, PWM type, with the following operational features:
 - a. Automatically regulate output voltage to within plus or minus 3 percent, for all load ranges and for maximum 25 percent step-load changes; regulation may increase to 8 percent for 100 percent step-load changes.
 - b. Automatically regulate output frequency to within plus or minus 1 Hz, from no load to full load, at unity power factor, over the operating range of battery voltage.
 - c. Output Voltage Waveform: Sine wave with maximum 3 percent TDD throughout battery operating-voltage range, for 100 percent linear load.
 - d. Inverter Overload Capability: 115 percent for 10 minutes; 150 percent surge for 10 seconds.
 - e. Load Power Factor: 0.5 lead to 0.5 lag.
 - f. Brownout Protection: Produces rated power without draining batteries when input voltage is down to 75 percent of normal.

J. Rectifier/Battery Charger:

- 1. Description: Solid state, variable rate, temperature compensated; automatically maintains batteries in fully charged condition when normal power is available.

2. Maximum Battery Recharge Time from Fully Discharged State: 24 hours.
3. Low-voltage disconnect circuit reduces battery discharge during extended power outages, monitors battery voltage, and disconnects inverter when battery voltage drops to no less than 85.7 percent of nominal voltage.

K. Batteries:

1. Description: Standard VRLA batteries.
 - a. Capable of sustaining full-capacity output of inverter unit for minimum of 90 minutes.
2. Battery Disconnect and OCPD: Manufacturer's standard.

L. Maintenance Bypass Systems:

1. Maintenance Bypass Mode: Internal; manual operation only; bypasses central battery equipment power circuits (inverter and static transfer switch); requires local operator selection at central battery equipment. Transfer and retransfer shall be make-before-break, without disrupting power to the load or causing system instabilities
2. Bypass Overload Capability: 1.5 times the base load current.

M. Integral Output Disconnecting Means and OCPD:

1. Single-Output OCPD: Thermal-magnetic circuit breaker, complying with UL 489; manufacturer's standard ratings based on unit output ratings.

2.2 ENCLOSURES

A. Central Battery Equipment Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1 steel cabinets with access to components through hinged doors with flush tumbler lock and latch.
2. Finish: Manufacturer's standard baked-enamel finish over corrosion-resistant prime treatment

2.3 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate central battery equipment fabricator's quality-control and testing methods.
- B. Testing: Test and inspect central battery equipment according to UL 924 and UL 1778.
- C. Factory Tests: Test and inspect assembled central battery equipment, by a qualified testing agency, according to UL 924 and UL 1778. Affix standards organization's label. Include the following:
 1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.
 2. Full-load test.

3. Transient-load response test.
 4. Overload test.
 5. Power failure test.
- D. Central battery equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store central battery equipment according to NECA 411.
- B. Examine areas, surfaces, and substrates to receive central battery equipment, with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.
- C. Examine equipment before installation. Reject equipment that is wet, moisture damaged, or mold damaged.
- D. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of central battery equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install central battery equipment and accessories according to NECA 411.
- C. Floor-Mounted Central Battery Equipment: Install central battery equipment on 4-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.

- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Comply with NECA 1.
- F. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- G. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- H. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 CONNECTIONS

- A. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping systems as indicated; comply with NFPA 70.
- C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 CONTROL WIRING INSTALLATION

- A. Bundle, train, and support wiring in enclosures.

3.5 IDENTIFICATION

- A. Identify central battery equipment, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label central battery equipment with engraved nameplates.
 - 3. Label each separate cabinet, for multicabinet units.
 - 4. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for central battery equipment, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of central battery equipment units.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Acceptance Testing Preparation:
 - 1. Inspect and Test Each Component:
 - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
 - b. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.
 - c. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Inspect central battery equipment, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
 - 2. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.
 - 3. Test continuity of each circuit.
 - 4. Verify that input voltages and frequencies at central battery equipment locations are within voltage and frequency limits specified in Part 2. If outside this range, notify Architect before closing input OCPDs.
 - 5. Perform each visual and mechanical inspection and electrical test stated in manufacturer's written instructions and in NETA Acceptance Testing Specification, including specifically those for batteries and battery chargers, regardless of the type of central battery equipment provided. Certify compliance with test parameters.
 - 6. Perform a load-duration test at rated voltage and rated output current to verify the correct functional operation of the unit under full-load stable operating conditions for the minimum time limits required by UL 924. Monitor and record ambient temperature and temperatures within the unit.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of central battery equipment. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- F. Central battery equipment will be considered defective if it does not pass tests and inspections.

- G. Prepare test and inspection reports, including a certified report that identifies central battery equipment and describes all test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, and other adjustable parts.
- C. Adjust the trip settings of thermal-magnetic circuit breakers with adjustable, instantaneous-trip elements; install fuses if not factory installed.
- D. Set the automatic system test parameters.

3.9 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace central battery equipment whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain central battery equipment, and to use and reprogram microprocessor-based control, monitoring, and display functions.

END OF SECTION 263323.11

SECTION 264313 – SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 CODES AND REFERENCE

- A. Qualification Data: Products shall be tested and listed by a Third Party testing lab or U.S. Department of Labor/OSHA approved NRTL.
 - 1. Agency Approval/Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
 - 2. All SPDs shall be tested and listed to ANSI/UL 1449-2015 (UL 1449 4th Edition) & Complimentary Listed to UL 1283 by a Nationally Recognized Testing Laboratory.
 - 3. Comply with the following:
 - a. IEEE C62.41
 - b. IEEE C62.45
 - c. NEMA LS 1
 - d. NEC Article 285

1.3 SUMMARY

- A. Section includes field installed SPDs for low-voltage power distribution equipment.

1.4 DEFINITIONS

- A. SPD: Surge Protective Device(s)
- B. NEC: National Electrical Code
- C. Sinewave Tracking (a.k.a. Frequency Responsive Circuitry): Voltage independent, dedicated circuitry intended to mitigate the effects of switching or ringing surges that is specifically designed so that it can survive the surge environment. The performance of sinewave tracking circuitry is defined by the level to which it mitigates Ring Wave transients and can be demonstrated in the test results of IEEE C62.41.2-2002, Category A Ring Wave (2kV).
- D. Voltage Protection Rating (VPR) A rating selected from a list of preferred values as detailed in ANSI/UL 1449-2015 (UL 1449 4th Edition) and assigned to each mode of protection. The value of VPR is determined as the nearest highest value taken from a list of preferred values as detailed in ANSI/UL 1449-2015 (UL 1449 4th Edition) to the measured limiting voltage

determined during the transient-voltage surge suppression test using the combination wave generator at a setting of 6 kV, 3 kA.

- E. Maximum Continuous Operating Voltage (MCOV) – The maximum designated root mean-square (rms) value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.
- F. Nominal Discharge Current (In) – Peak value of the current, selected by the manufacturer from a list of values specified in ANSI/UL 1449-2015 (UL 1449 4th Edition), through the SPD having a current waveshape of 8/20 where the SPD remains functional after 15 surges using the test procedure described in ANSI/UL 1449-2015 (UL 1449 4th Edition) .
- G. Type 1 SPD – Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and intended to be installed without an external overcurrent protective device.
- H. Type 2 SPD – Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device; including SPDs located at the branch panel.
- I. Modes Of Protection: Electrical paths where the SPD offers defense against transient overvoltages. e.g. Line to Neutral (L-N), Line to Ground (L-G), Line to Line (L-L) and Neutral to Ground (N-G).

1.5 SUBMITTALS FOR REVIEW

- A. Product Data: For each type of product indicated, include all required testing and pertinent manufacturer information described herein in Section 1.6, rated capacities, maximum continuous operating voltage, weights and dimensions, electrical characteristics interconnecting wiring requirements, accessories, and ANSI/UL 1449-2015 (UL 1449 4th Edition) VPRs.
- B. Warranty duration and replacement policy.
- C. Manufacturer's installation instructions. For externally mounted units, include written documentation indicating manufacturer's recommended circuit breaker rating.
- D. Provide a table indicating which panel each SPD will serve. Table shall include panel name, and associated SPD model number to be provided.

1.6 SUBMITTALS FOR INFORMATION

- A. IEEE Std C62.41.2TM-2002 test reports. Include complete let-through voltage/measured limiting voltage test data, test graphs and scope traces for each and every mode for each product submitted. Testing shall be conducted as follows:
- B. Certificates of Conformity: For SPDs, certifying compliance with an NRTL listing/certification to the following standards:
 - 1. ANSI/UL 1449-2015 (UL 1449 4th Edition)
 - 2. UL 1283 (Type 2 SPDs Only)

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Closeout Submittal shall include operation, installation and specification data in closeout submittals.
- B. Certification: By Installer that installation complies with manufacturer's instructions. See final inspection section of this specification.
- C. Warranty duration and replacement policy

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.
- B. Manufacturer's Qualifications: Manufacturer must have at least 10 years experience in the engineering, design and manufacture of permanently connected SPDs.

1.9 COORDINATION

- A. Coordinate location of field installed SPDs to allow adequate clearances for maintenance.
- B. SPDs shall be rated for the class and category of service necessary for the application per the ANSI/IEEE Std C62.41.2TM-2002 and IEEE Std C62.72TM-2007.

1.10 FUSING

- A. Provide as a minimum, over-current, over temperature protection in the form of component-level thermal fusing to ensure safe failure and mitigate thermal runaway. This component-level fusing shall be an integral part of the MOV itself, and not silver wire or other independently layed across each MOV.
- B. Provide integral short circuit current fusing with each device. The fusing will be independent of the "component-level" fusing and specifically for over-current protection and shall be constructed utilizing surge rated, cartridge fuses and not rated 'silver-fuse-wire' or other.
- C. The fusing mechanisms employed must effectively coordinate their performance in conjunction with the high current abnormal over-voltage testing under ANSI/UL 1449-2015 (UL 1449 4th Edition).

1.11 WARRANTY

- A. During the Product Warranty Period, the manufacturer of the SPD shall provide unlimited free replacement of the entire SPD not just modules, components or sub-assemblies for any SPD that ceases to properly function as a direct result of any electrical anomaly, including damage caused as a result of lightning. Acceptable manufacturers that do not meet the Warranty requirements specified herein shall submit a letter extending their warranty to conform to the

Warranty requirements specified herein. The warranty extension letter shall be submitted along with the product data submittal.

1. Product Warranty Period (Externally Mounted SPD's): Minimum Twenty-Five (25) years from date of installation.
2. Maintenance Restrictions: No SPD shall be supplied which requires scheduled preventative-maintenance or replaceable parts other than replaceable LEDs or batteries for diagnostic circuits. Units requiring functional testing, special test equipment, or special training to monitor SPD status are not acceptable. SPDs shall require no routine maintenance. SPDs are considered non-repairable items and shall be fully replaced upon failure.

PART 2 - PRODUCTS

2.1 SURGE PROTECTION DEVICES (SPDs)

- A. Service Entrance Equipment: Peak-Surge Current shall be 300 kA minimum per phase, 100 kA minimum per mode. Provide true 10-mode protection with 10 individual, dedicated, discrete modes of protection for three-phase wye systems. Subject to compliance with requirements, available manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 1. Surge Suppression Incorporated
 2. Advanced Protection Technologies Inc., XAL Series
 3. PSP Products Incorporated, Typhoon All-Mode V Series
- B. Branch Circuit Panelboards less than 400A: Peak-Surge Current shall be 120 kA minimum per phase with sine-wave tracking (see section 1.6 for sinewave tracking compliance requirements). 40 kA minimum per mode. Provide true 10-mode protection with 10 individual, dedicated, discrete modes of protection for three-phase wye systems. Subject to compliance with requirements, available manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 1. Surge Suppression Incorporated
 2. Advanced Protection Technologies Inc.
 3. PSP Productmis Incorporated
- C. All SPDs on the entire project shall be provided by the same SPD manufacturer to ensure commonality and ease of Owner maintenance.
- D. SPDs shall be:
 1. Listed to ANSI/UL 1449-2015 (UL 1449 4th Edition)
 2. SPD shall be Type 1 or Type 2. Type 4 SPDs are not permitted
 3. SPD shall have a Nominal Discharge Current Rating of 20 kA per mode for all modes.
 4. The Maximum Continuous Operating Voltage (MCOV) shall be as follows:

Nominal System Voltage	Mode	MCOV
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120/208 Wye	L-N	150 V
	L-L	300 V
	L-G	150 V
	N-G	150 V
Nominal System Volt-age	Mode	MCOV
277/480 Wye	L-N	320 V
	L-L	550 V
	L-G	320 V
	N-G	320 V

5. The SPD shall have Voltage Protection Ratings (VPRs) as follows:

Nominal System Voltage	Mode		VPR
120/208 Wye	L-N	150 V	600 V
	L-L	300 V	1000 V
	L-G	150 V	600 V
	N-G	150 V	600 V
Nominal System Voltage	Mode		VPR
277/480 Wye	L-N	320 V	1000 V
	L-L	550 V	1800 V
	L-G	320 V	1200 V
	N-G	320 V	1200 V

6. LED indicator lights for power and protection status.
7. Permanently-mounted, parallel connected.
8. Solid-state clamping components to limit the surge voltage and divert the surge current. SPD components that "crowbar" (e.g. spark gaps, gas tubes, SCR's, etc.) are not allowed.
9. Self-restoring and fully automatic.
10. Capable of sustaining 115% of nominal RMS voltage continuously without degrading.
11. The SPD shall be tested and listed by an NRTL as a complete assembly to a symmetrical fault current rating greater than or equal to the available fault current at the location of installation at the connected panel, in accordance with NEC Article 285 and shall be marked with the short circuit current rating (SCCR). The SCCR of the SPD shall be 200 kAIC.
12. Bi-directional, thermal stress reducing, encapsulated, custom parallel and solid state circuit configuration.
13. Distinct and independent protection circuitry for each mode is required.

2.2 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install SPDs in strict accordance with manufacturer's instructions and the NEC.
- B. Install SPDs with conductors between SPD and the branch circuit breaker as short and straight as possible. When possible do not exceed manufacturer's recommended lead length. In the case where the lead length exceeds 14 inches the installer must contact the SPD manufacturer for installation assistance.
- C. Install the SPDs immediately adjacent to the panelboard being protected.
- D. Unless otherwise recommended by the SPD manufacturer, SPDs must be installed to a branch circuit breaker in the panel to ensure a means of disconnecting the SPD from the service without de-energizing the panel or the connected loads. Circuit breaker shall be rated for 60-amps or 30 amps in accordance with manufacturer's written installation instructions.
- E. Do not energize service entrance equipment or panelboards until SPDs are properly installed and connected.
- F. Do not perform insulation resistance tests of the distribution wiring equipment with the SPDs installed. Disconnect all SPDs, all Phase, Neutral and Ground connections before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.2 FIELD QUALITY CONTROL

- A. Field Service: Electrical Contractor shall inspect, test, and adjust components, assemblies, and equipment installations, including connections to comply with this specification.
 - 1. Verify that electrical wiring installation complies with manufacturer's written installation requirements and NEC requirements
 - 2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Complete startup checks according to manufacturer's written instructions.
 - 4. An SPD will be considered defective if it does not pass tests and inspections.
 - 5. Prepare test and inspection reports.

3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Interior solid-state luminaires that use LED technology.
 - 2. Exit Signs.
 - 3. Luminaire supports.

- B. Related Requirements:

- 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. BIM: Building information model.
- B. CAD: Computer-aided design.
- C. CCT: Correlated color temperature.
- D. CRI: Color Rendering Index.
- E. LED: Light-emitting diode.
- F. Fixture: See "Luminaire."
- G. IP: International Protection or Ingress Protection Rating
- H. Lumen: Measured output of lamp and luminaire, or both.
- I. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
5. Include photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps, and accessories identical to those indicated for the luminaire as applied in this Project. Comply with IES LM-79 and IES LM-80 for LED luminaires.
 - a. Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Product Certificates: For each type of luminaire
- C. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in maintenance manuals.
 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for LED Luminaires: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. Bulb shape complying with ANSI C79.1.
- D. Lamp base complying with ANSI C81.61.
- E. Nominal Operating Voltage: Refer to Contract Drawings.
- F. Recessed Luminaires: Comply with NEMA LE 4.
- G. Minimum CRI for LED luminaires: 80

- H. CCT for LED luminaires: Refer to Contract Drawings.
- I. Rated lamp life for LED luminaires: 50,000 hours
- J. Dimming range for LED luminaires: 100 percent to 5 percent.
- K. Provide LED luminaires with internal driver.

2.2 MATERIALS

A. Metal Parts:

- 1. Free of burrs and sharp corners and edges.
- 2. Sheet metal components shall be steel unless otherwise indicated.
- 3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers:

- 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- 2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

- 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved by the Architect and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish shall match luminaire.
- C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- F. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- G. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
 4. Do not use ceiling grid as support for pendant luminaires. Connect support cables or rods to building structure.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
- B. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- C. Luminaire will be considered defective if it does not pass operation tests and inspections.

END OF SECTION 265100

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding labeling.

1.3 DEFINITIONS

- A. TBC: Telecommunications bonding conductor.
- B. TMGB: Telecommunications main grounding busbar.
- C. TBB: Telecommunications bonding backbone.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For communications equipment room. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. TBC, TMGB, and routing of their bonding conductors.
- B. Qualification Data: For Installer, installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Result of the ground-resistance test, measured at the point of BCT connection.
 - b. Result of the bonding-resistance test at TMGB and its nearest grounding electrode.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Contractor with a minimum of five years documented successful installation experience on projects utilizing cabling infrastructure work similar to that required for this project. The contractor shall be an experienced firm regularly engaged in the layout and the installation of cabling infrastructure systems. The contractor must be able to show evidence of successfully completed projects of similar size and scope in the last 12 months. The contractor shall be a manufacturer certified Business Partner. BICSI registration must be current and the installer and technicians must be in good standing. Contractor employees shall always wear visible ID badges on the job site with current picture and company name.
 - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall always be present when Work of this Section is performed at Project site.
 - 2. The work force shall be minimum 15% BICSI certified Technician, 15% BICSI certified installer level 2 and 15% BICSI certified installer level 1.
 - 3. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with TIA-607-B.

2.2 CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Harger Lightning & Grounding.
 - 2. Panduit Corp.

3. TE Connectivity Ltd.
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
- D. Bare Copper Conductors:
 1. Solid Conductors: ASTM B3.
 2. Stranded Conductors: ASTM B8.
 3. Tinned Conductors: ASTM B33.
 4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick. Telecommunications Bonding Conductor TBC and Bonding Backbone conductor TBB shall be as indicated on the drawings.

2.3 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Burndy; Part of Hubbell Electrical Systems.
 2. Chatsworth Products, Inc.
 3. Harger Lightning & Grounding.
 4. Panduit Corp.
 5. TE Connectivity Ltd.
- B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 1. Electroplated tinned copper, C and H shaped.
- D. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.
- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Chatsworth Products, Inc.
 2. Harger Lightning & Grounding.
 3. Panduit Corp.
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
1. Predrilling shall be with holes for use with lugs specified in this Section.
 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.
1. Cabinet-Mounted Busbar: Terminal block, with copper-plated hardware for attachment to the cabinet.

2.5 IDENTIFICATION

- A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of TBC connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the TBC only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, size as indicated.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch intervals.
 - 4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing and bond both ends of the conduit to the TMGB.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The TBC between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pre twist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Telecommunications Enclosures: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond TMGB to the vertical steel of the building frame.
- F. Shielded Cable: Bond the shield of shielded cable to the TMGB in communications room. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.
- G. Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.7 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 - 2. Label the TBC and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
 - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB. Maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the TBC exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 270526

SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for labels and signs.
 - 2. Labels.
 - 3. Tapes.
 - 4. Cable ties.
 - 5. Fasteners for labels and signs.
- B. Identification shall be in accordance with TIA606B and UNC Wilmington Information Technology Network Group.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for communications identification products.
- B. Identification Schedule:
 - 1. Outlets: Scaled drawings indicating location and proposed designation.
 - 2. Backbone Cabling: Riser diagram showing each communications room, backbone cable, and proposed backbone cable designation.
 - 3. .

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70 and TIA 606-B.
- B. Comply with ANSI Z535.4 for safety signs and labels.
- C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Brady Corporation.
 - b. Champion America.
 - c. emedco.
 - d. Grafoplast Wire Markers.
 - e. HellermannTyton.
 - f. LEM Products Inc.
 - g. Marking Services, Inc.
 - h. Panduit Corp.
 - i. Seton Identification Products.

B. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. A'n D Cable Products.
 - b. Brady Corporation.
 - c. Brother International Corporation.
 - d. emedco.
 - e. Grafoplast Wire Markers.
 - f. HellermannTyton.
 - g. Ideal Industries, Inc.
 - h. LEM Products Inc.
 - i. Marking Services, Inc.
 - j. Panduit Corp.
 - k. Seton Identification Products.
2. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 UNDERGROUND-LINE WARNING TAPE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Brady Corporation.
 - 2. Ideal Industries, Inc.
 - 3. LEM Products Inc.
 - 4. Marking Services, Inc.
 - 5. Reef Industries, Inc.
 - 6. Seton Identification Products.
- B. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- C. Color and Printing:
 - 1. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, and ANSI Z535.4.
 - 2. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL-FIBER CABLE".
- D. Tag: Type ID:
 - 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - 2. Width: 3 inches.
 - 3. Overall Thickness: 5 mils.
 - 4. Foil Core Thickness: 0.35 mil.
 - 5. Weight: 28 lb/1000 sq. ft..
 - 6. Tensile according to ASTM D882: 70 lbf and 4600 psi.

2.5 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. HellermannTyton.
 - 2. Ideal Industries, Inc.
 - 3. Marking Services, Inc.
 - 4. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F according to ASTM D638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F according to ASTM D638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.
- G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

H. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
3. Provide label 6 inches from cable end.

I. Underground-Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

J. Cable Ties: General purpose, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.
1. System legends shall be as follows:
 - a. Telecommunications.
- D. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation in accordance with TIA 606B.
- E. Equipment Room Labeling:
1. Frames and Enclosures: Identify front and rear of each with self-adhesive labels in accordance with TIA 606B .
 2. Patch Panels: In accordance with TIA 606B
 3. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed in accordance with TIA 606B
 - a. Colon.
 - b. Faceplate number.

- F. Backbone Cables: Label each cable with a vinyl-wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.
- G. Horizontal Cables: Label each cable with a vinyl-wraparound label in accordance with TIA 606B.
- H. Locations of Underground Lines: Underground-line warning tape for copper, coaxial, hybrid copper/fiber, and optical-fiber cable.
- I. Instructional Signs: Self-adhesive labels.
- J. Equipment Identification Labels:
 - 1. Indoor Equipment: Self-adhesive label.
 - 2. Equipment to Be Labeled:
 - a. Communications cabinets.

END OF SECTION 270553

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Backboards.
 - 2. Boxes, enclosures, and cabinets.
 - 3. Power strips.
- B. Related Requirements:
 - 1. Section 271313 "Communications Copper Backbone Cabling" for copper data cabling associated with system panels and devices.
 - 2. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.
 - 3. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. RCDD: Registered communications distribution designer.
- D. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- E. TMGB: Telecommunications main grounding bus bar.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Contractor with a minimum of five years documented successful installation experience on projects utilizing cabling infrastructure work similar to that required for this project. The contractor shall be an experienced firm regularly engaged in the layout and the installation of cabling infrastructure systems. The contractor must be able to show evidence of successfully completed projects of similar size and scope in the last 12 months. The contractor shall be a manufacturer certified Business Partner. BICSI registration must be current and the installer and technicians must be in good standing. Contractor employees shall always wear visible ID badges on the job site with current picture and company name.
 1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
 2. Installation Supervision: Installation shall be under direct supervision of RCDD or Technician, who shall be present at all times when Work of this Section is performed at Project site.
 3. The work force shall be minimum 15% BICSI certified Technician, 15% BICSI certified installer level 2 and 15% BICSI certified installer level 1.
 4. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 BACKBOARDS

- A. Backboards: Plywood, 3/4 by 48 by 96 inches.
- B. Backboard Paint: Light-colored fire-retardant paint.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Adalet.
2. Crouse-Hinds, an Eaton business.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a brand of nVent.
7. Hubbell Incorporated.
8. Hubbell Incorporated; Wiring Device-Kellems.
9. Kraloy.
10. Milbank Manufacturing Co.
11. MonoSystems, Inc.
12. Oldcastle Enclosure Solutions.
13. O-Z/Gedney; a brand of Emerson Industrial Automation.
14. Plasti-Bond.
15. RACO; Hubbell.
16. Spring City Electrical Manufacturing Company.
17. Stahlin Non-Metallic Enclosures.
18. Thomas & Betts Corporation; A Member of the ABB Group.
19. Topaz Electric; a division of Topaz Lighting Corp.
20. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed and labeled for intended location and use.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Device Box Dimensions: 4-11/16 inches square by 2-1/8 inches deep.

G. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

H. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting, with detachable flanges.
3. Height: 1 RU..
4. Housing: Metal.
5. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
6. Rear-facing receptacles.
7. LED indicator lights for power and protection status.
8. LED indicator lights for reverse polarity and open outlet ground.
9. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
10. Cord connected with 15-foot line cord.
11. Rocker-type on-off switch, illuminated when in on position.
12. Surge Protection: UL 1449, Type 3.
 - a. Maximum Surge Current, Line to Neutral: 27 kA.
 - b. Protection modes shall be line to neutral, line to ground, and neutral to ground.
 - c. UL 1449 Voltage Protection Rating for line to neutral and line to ground shall be 600 V for neutral to ground.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.
 1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
 4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- G. Backboards:
 - 1. Install from 6 inches to 8 feet, 6 inches above finished floor.
 - 2. Paint all sides of backboard with two coats of fire resistant white paint.
 - 3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

3.2 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices" Ch.

END OF SECTION 271100

SECTION 271313 - COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. High-count Category 3 twisted pair cable.
 - 2. Outside Plant copper cable.
 - 3. Building protection module.
 - 4. 110 punch down blocks.
 - 5. Twisted pair cable hardware, including plugs, jacks, patch panels, and cross-connects.
 - 6. Grounding provisions for twisted pair cable.
 - 7. Cabling identification.
 - 8. Source quality control requirements for twisted pair cable.

- B. Related Requirements:

- 1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- E. LAN: Local area network.
- F. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- G. RCDD: Registered Communications Distribution Designer.
- H. OSP: Outside Plant Cables.
- I. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER BACKBONE CABLING DESCRIPTION

- A. Copper backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of OSP cables, backbone cables, building protection assembly, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. Cabling administration Drawings and printouts.
 - 2. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications pathways.
 - c. Telecommunications system access points.
 - d. Telecommunications grounding system
 - e. Cross-connects.
 - 3. Cross-Connects: Detail mounting assemblies, and show elevations and physical relationship between the installed components.
- C. Copper backbone cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD, Installer, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Product Certificates: For each type of product.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Contractor with a minimum of five years documented successful installation experience on projects utilizing cabling infrastructure work similar to that required for

this project. The contractor shall be an experienced firm regularly engaged in the layout and the installation of cabling infrastructure systems. The contractor must be able to show evidence of successfully completed projects of similar size and scope in the last 12 months. The contractor shall be a manufacturer certified Business Partner. BICSI registration must be current and the installer and technicians must be in good standing. Contractor employees shall always wear visible ID badges on the job site with current picture and company name.

1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings, cabling administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of RCDD or Technician, who shall always be present when Work of this Section is performed at Project site.
3. The workforce shall be minimum 15% BICSI certified Technician, 15% BICSI certified installer level 2 and 15% BICSI certified installer level 1.
4. Testing Supervisor: Currently certified by BICSI as an RCDD or a Technician to supervise on-site testing.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's Information Technology Network Group.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Products supplied shall be designed and manufactured for copper outside plant or interior backbone cable.

2.2 TELECOMMUNICATION ENTRANCE FACILITY

- A. Building Protector Assembly: Provide self-contained 5 pin unit with 110 punch down blocks in and 110 punch down blocks out to terminate 25 pair of outside plant cable in and 25 pair backbone out.
- B. Protector Module: Provide in accordance with UL 497, three electrode solid state type 5 pin. Protection modules shall have a maximum impulse level of 20 kA and 200A discharge current. Provide one surge protection module for each pair of OSP cable.

2.3 WIRE AND CABLE

- A. Copper Conductor Outside Plant Cable (OSP): Solid copper conductors covered with solid insulating compound. Insulated conductors are twisted into pairs to form a cylindrical core. Cable shall have a core wrapping, copper or aluminum shield and exterior jacket. Cable shall be PE-89 with 24 AWG copper conductors and filled compound meeting ICEA 5-99-698 and RUS 1755.390.
- B. Interior Copper Telecommunications Cabling: Cabling shall be UL listed for the application and shall comply with TIA-568-C.0, TIA-568-C.1, TIA-568-C.2, TIA-568-C.3 and NFPA 70. Ship cable with manufacturer data for unshielded twisted pair (UTP).
- C. Copper Backbone cable shall be solid copper, 24AWG, 100 ohm, Category 3, UTP in accordance with ICEA S-90-661, TIA-568-C.1, TIA-568-C.2 and UL444, covered with a gray thermoplastic jacket. Jacket shall be printed with manufacturer name, flammability rating, gauge of conductor, category designation at regular intervals. Cable shall be rated CMP, CMB or CM in accordance with NFPA 70. Use of a higher rated cable is permissible.

2.4 HARDWARE

- A. Hardware is designed to terminate copper backbone cable.
- B. Connector blocks shall be insulation displacement connector (IDC) type 110 cross connect block with legs for mounting on plywood backboard.
- C. Cable Guides: Provide cable guides designed for the purpose of routing cables on plywood backboards.

2.5 CABLING IDENTIFICATION

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA-568-C.1.
- C. Factory test cables according to TIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point.

3.2 WIRING METHOD FOR OUTSIDE PLANT CABLE

- A. Install OSP copper cables in underground duct and manhole system as indicated. Swab out duct to remove foreign materials prior to pulling cables. Provide cable lubricants recommended by the cable manufacturer.
- B. Cable Tension: Obtain the maximum cable pulling tension from the cable manufacturer. Do not exceed this pulling tension when installing the cable.
- C. Installation of cables in manholes and handholes install cables along walls providing the maximum spare cable. Form cables along walls to no interfere with duct entrances and support cables on brackets and insulators. Provide each cable with an enclosed tag with information as directed by the Information Technology Network Group.

3.3 WIRING METHODS FOR BACKBONE CABLE

- A. Wiring Method: Install cables in raceways .

3.4 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets specified in Section 271100 "Communications Equipment Room Fittings."
- B. Drawings indicate general arrangement of pathways and fittings.

3.5 INSTALLATION OF COPPER BACKBONE CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM)," Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at terminals, cross-connects.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from terminals.
6. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section Use lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.

- c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
- 4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
- 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

3.7 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.8 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform Tests and Inspections:
 - 1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- E. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
- F. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- G. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

END OF SECTION 271313

SECTION 271323 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. 9/125 micrometer single-mode, outside plant optical fiber cable (OS2).
 - 2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
 - 3. Cabling identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. RCDD: Registered Communications Distribution Designer.

1.4 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

- A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics including the following:
 - a. Telecommunications pathways.
 - b. Telecommunications system access points.
 - c. Telecommunications grounding system.
 - d. Cross-connects.
 - e. Patch panels.
 - f. Patch cords.
5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Optical fiber cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD, or Installer, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Product Certificates: For each type of product.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Contractor with a minimum of five years documented successful installation experience on projects utilizing cabling infrastructure work similar to that required for this project. The contractor shall be an experienced firm regularly engaged in the layout and the installation of cabling infrastructure systems. The contractor must be able to show evidence of successfully completed projects of similar size and scope in the last 12 months. The contractor shall be a manufacturer certified Business Partner. BICSI registration must be current and the installer and technicians must be in good standing. Contractor employees shall always wear visible ID badges on the job site with current picture and company name.
 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of RCDD or Technician Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 3. The workforce shall be minimum 15% BICSI certified Technician, 15% BICSI certified installer level 2 and 15% BICSI certified installer level 1.

4. Corning Optical Communications Network of preferred installer certification.
 5. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD or Technician.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Test cables upon receipt at Project site.
1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
- 1.10 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 1.11 COORDINATION
- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- 1.12 EXTENDED WARRANTY
- A. Communications optical fiber backbone system shall have an extended warranty of 25 years. All products in the system shall be Corning Optical Communications and the installer shall be an active participant in the Network of Preferred Installers program offered by Corning.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.2 9/125 MICROMETER, SINGLE-MODE, INSIDE PLANT OPTICAL FIBER CABLE (OS1) MIC

- A. Description: Single mode, 9/125-micrometer, 12 fibers, tight buffered, optical fiber cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Corning Optical Communications.
- C. Standards:
 - 1. Comply with TIA-492CAAA for detailed specifications.
 - 2. Comply with TIA-568-C.3 for performance specifications.
 - 3. Comply with ICEA S-83-596 for mechanical properties.
- D. Maximum Attenuation: 1.0 dB/km at 1310 nm; 1.0 dB/km at 1550 nm.
- E. Jacket:
 - 1. Jacket Color: Yellow.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
- F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - 1. Riser Rated, Nonconductive: Type OFNR or Type OFNP, complying with UL 1666.
 - 2. Riser Rated, Nonconductive: Type OFNP or Type OFNR in listed riser or plenum communications raceway.

2.3 9/125 MICROMETER SINGLE-MODE, OUTSIDE PLANT OPTICAL FIBER CABLE (OS2) ALTOS

- A. Description: Single mode, 9/125-micrometer, 24 fibers, stranded loose tube, optical fiber cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Corning Optical Communications.
- C. Standards:
 - 1. Comply with TIA-492CAAB for detailed specifications.
 - 2. Comply with TIA-568-C.3 for performance specifications.
 - 3. Comply with ICEA S-87-640 for mechanical properties.
- D. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.
- E. Jacket:
 - 1. Jacket Color: Black.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.4 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Corning Optical Communications.
- B. Standards:
 1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
 2. Comply with TIA-568-C.3.
- C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- D. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
- E. Connector Type: Type LC complying with TIA-604-10-B, connectors.
- F. Plugs and Plug Assemblies:
 1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
 2. Insertion loss not more than 0.25 dB.
 3. Marked to indicate transmission performance.
- G. Jacks and Jack Assemblies:
 1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
 2. Insertion loss not more than 0.25 dB.
 3. Marked to indicate transmission performance.
 4. Designed to snap-in to a patch panel or faceplate.

2.5 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.
- C. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters.
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.
- B. General Requirements for Optical Fiber Cabling Installation:
 - 1. Comply with TIA-568-C.1 and TIA-568-C.3.
 - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot-long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 GROUNDING

- A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- D. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Label each unit and field within distribution racks and frames.
 - 4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:
 - 1. Flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
 - 1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-

- coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
- 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
- 3. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.
- F. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- G. Remove and replace cabling where test results indicate that it does not comply with specified requirements.
- H. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- I. Prepare test and inspection reports.

END OF SECTION 271323

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Category 6 twisted pair cable.
 - 2. Category 6a twisted pair cable.
 - 3. Twisted pair cable hardware, including plugs and jacks.
 - 4. Cable management system.
 - 5. Cabling identification products.
 - 6. Grounding provisions for twisted pair cable.
 - 7. Source quality control requirements for twisted pair cable.

1.3 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. F/UTP: Overall foil screened cable with unscreened twisted pair.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- G. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- H. RCDD: Registered Communications Distribution Designer.
- I. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- J. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- K. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable cabling system shall provide interconnections between Telecommunications Room Distributor A, Distributor B, or Distributor C, and the outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, patch panels, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
 - 1. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length is as measured by the instrument used for horizontal cable testing.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Cabling administration Drawings and printouts.
 - 3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications pathways.
 - c. Telecommunications system access points.
 - d. Telecommunications grounding system.
 - e. Telecommunications conductor drop locations.
 - f. Typical telecommunications details.
 - g. Mechanical, electrical, and plumbing systems.
- C. Twisted pair cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For RCDD, Installer, installation supervisor, and field inspector.
- B. Product Certificates: For each type of product.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Contractor with a minimum of five years documented successful installation experience on projects utilizing cabling infrastructure work similar to that required for this project. The contractor shall be an experienced firm regularly engaged in the layout and the installation of cabling infrastructure systems. The contractor must be able to show evidence of successfully completed projects of similar size and scope in the last 12 months. The contractor shall be a manufacturer certified Business Partner. BICSI registration must be current and the installer and technicians must be in good standing. Contractor employees shall always wear visible ID badges on the job site with current picture and company name.
1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings, cabling administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of an RCDD or Technician, who shall always be present when Work of this Section is performed at Project site.
 3. The workforce shall be minimum 15% BICSI certified Technician, 15% BICSI certified installer level 2 and 15% BICSI certified installer level 1.
 4. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.9 EXTENDED WARRANTY

- A. Communications copper cabling system including Category 6 and Category 6A copper cables, workstation jacks, patch panel jacks and patch cords carry a twenty year extended warranty. The end to end copper manufactured solution will require the use of one of the following 3 selections:
1. CommScope SYSTIMAX
 - a. GigaSPEED XL Category 6.
 - b. GigaSPEED X10D X91B Category 6A.
 - c. Communications copper cabling system installer shall be an active participant in the Partner Pro Network program offered by CommScope SYSTIMAX.
 2. CommScope NETCONNECT
 - a. Uniprise CAT 6 CS37.
 - b. Uniprise CAT6A CS47.
 - c. Communications copper cabling systems installer shall be an active participant in the Partner Pro Network program offered by CommScope NETCONNECT.
 3. Belden
 - a. Category 6 System 3600 bonded-pairs.
 - b. Category 6A 10GXS bonded-pairs.
 - c. Communications copper cabling systems installer shall be an active participant in the Partner Alliance program offered by Belden.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's Information Technology Network Group.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
 - 1. Communications Plenum Rated: Type CMP complying with UL 1685.

2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following as listed in the Extended Warranty Paragraphs:
 - 1. CommScope NETCONNECT.
 - 2. CommScope SYSTIMAX.
 - 3. Belden.

- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Shielding/Screening: Unshielded twisted pairs (UTP).
- E. Cable Rating: Plenum.
- F. Jacket: White-Voice, Yellow-Data thermoplastic.

2.4 CATEGORY 6a TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following as listed in the Extended Warranty Paragraphs:
 - 1. CommScope NETCONNECT.
 - 2. CommScope SYSTIMAX.
 - 3. Belden.
- C. Standard: Comply with TIA-568-C.2 for Category 6a cables.
- D. Shielding/Screening: Unshielded twisted pairs (UTP) or Screened twisted pairs (F/UTP).
- E. Cable Rating: Plenum.
- F. Jacket: Purple thermoplastic.

2.5 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following as listed in the Extended Warranty Paragraphs:
 - 1. CommScope NETCONNECT.
 - 2. CommScope SYSTIMAX.
 - 3. Belden.
- C. General Requirements for Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6 Category 6a.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.
- D. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, as listed in the Extended Warranty paragraph.
- E. Connecting Blocks:

1. 110-style IDC for Category 6.
 2. 110-style IDC for Category 6a.
 3. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
 3. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- G. Patch Cords: Factory-made, four-pair cables in 50% 36-inch, 50% 48-inch lengths. Patch cords shall match the structured cabling solution installed. Provide patch cords for both ends. Each cable installed shall have one patch cord for the work area outlet and cabinet end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
- H. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 2. Standard: Comply with TIA-568-C.2.
 3. Marked to indicate transmission performance.
- I. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 2. Designed to snap-in to a patch panel or faceplate.
 3. Standard: Comply with TIA-568-C.2.
 4. Marked to indicate transmission performance.
- J. Faceplate:
1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
 2. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
- K. Legend:
1. Machine printed, in the field, using adhesive-tape label.

2.6 CABLE MANAGEMENT SYSTEM

- A. Description: Computer-based cable management system, with integrated database and graphic capabilities.
- B. Document physical characteristics by recording the network, TIA details, and connections between equipment and cable.
- C. Information shall be presented in database view, schematic plans, or technical drawings.
 - 1. Microsoft Visio Professional or AutoCAD drawing software shall be used as drawing and schematic plans software.
- D. System shall interface with the following testing and recording devices:
 - 1. Direct upload tests from circuit testing instrument into the personal computer.
 - 2. Direct download circuit labeling into labeling printer.

2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.8 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

2.9 SOURCE QUALITY CONTROL

- A. Factory test cables on reels according to TIA-568-C.1.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways, except within consoles, cabinets, desks, and counters.

- B. Wiring within Equipment Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."
- B. Comply with Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Comply with Section 260529 "Hangers and Supports for Electrical Systems."
- D. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
 - 2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
- C. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Group connecting hardware for cables into separate logical fields.
- E. Separation from EMI Sources:
1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

- A. Install grounding according to the Section 270526 "Grounding, Bonding, for Communications Systems."
- B. Comply with TIA-607-B and NECA/BICSI-607.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
 - 1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint and label colors for equipment identification shall comply with TIA-606-B.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
 - b. Label each unit and field within distribution racks and frames.
 - 4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
 - 1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 271513

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Device guards.
6. Addressable interface device.
7. Isolator module.
8. Digital alarm communicator transmitter.
9. Network communications.
10. System printer.

- B. Related Requirements:

1. Section 260523 "Control-Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PC: Personal computer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 2. Include rated capacities, operating characteristics, and electrical characteristics.

3. Submittal shall provide mA draw for each device submitted and the listed minimum voltage required to operate. Panel submittal shall list voltage drop allowed for panel and for individual NAC circuits.
- B. Shop Drawings: For fire-alarm system.
1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 2. Include plans, elevations, sections, details, and attachments to other work.
 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 4. Detail assembly and support requirements.
 5. Include battery-size calculations.
 6. Include input/output matrix.
 7. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
 8. Include performance parameters and installation details for each detector.
 9. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits, including fill percentage, and point-to-point wiring diagrams.
- C. Battery Calculations
1. Include a copy of system battery sizing calculations with the shop drawing submittal to the engineer. Use manufacturer's battery discharge curve to determine expected battery voltage after 24 hours of providing battery power.
 2. Fire Alarm Vendor's calculations must be submitted with the shop drawings, and prior to installation of equipment.
 3. The voltage drop at EOL must not exceed 14 percent of the expected battery voltage, after the required standby time plus alarm time.
 4. All of these calculations must be placed on a dedicated sheet of as-built drawings, for future reference by fire alarm service technicians. NAC voltage drop is to be verified during system tests.
- D. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level III minimum.
 - c. Licensed or certified by authorities having jurisdiction.
- E. Delegated-Design Submittal: For smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria.
1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
 2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

- F. Engineer's approval (with or without corrections) of contractor's shop drawings, samples, cut sheets, etc., is for general conformance with the contract documents and design concept. It shall not relieve the contractor of responsibility for full compliance with the project plans and specifications, EXCEPT for any specific non-compliant features for which the engineer gives written authorization.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
 - 1. Submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names, addresses, and telephone numbers in the certification.
 - 2. Installer's training certificate.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Record copy of site-specific software.
 - g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - h. Manufacturer's required maintenance related to system warranty requirements.
 - i. Abbreviated operating instructions for mounting at fire-alarm control unit.
 - j. The as-built "calculations."

2. The contractor shall submit maintenance data and parts list for each type of fire alarm equipment installed, including furnished specialties and accessories., Include this data, product data, and shop drawings in maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

C. Installation Instructions: The contractor shall submit to the Engineer of Record the manufacturer's detailed installation instruction for the Fire Alarm Control Panel and all duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.

D. Provide electronic copies of all fire alarm system as-builts and zone maps.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- | | |
|--|---------------------------|
| 1. Fuses (If Used) | 2 of each size in system |
| 2. Manual Fire Alarm Boxes | 2% of installed quantity. |
| 3. Addressable Control Relays | 4% of installed quantity |
| 4. Monitor Modules (Addressable Interface) | 4% of installed quantity |
| 5. Isolation Modules/Isolation Bases | 4% of installed quantity |
| 6. Spot-Type Smoke Detectors/Sounder Bases | 6% of installed quantity |

1.8 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristic required, and whose products are listed and labeled. Products of firms that do not maintain factory authorized service organization and spare parts stock are not acceptable for use on State Owned Building.

B. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

C. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

D. Installer Qualification: Company specializing in performing the work and making the final terminations and connections. Minimum of 5 years documented experience installing fire detection and alarm systems similar in size and scope of the project. Only the Installer may make program changes and must be present for the 100% test, Designer's pre-final review and Owner inspections.

E. All connections to the FACP and the systems programming shall be done only by the manufacturer's, or by an authorized distributor that stocks a full complement of spare parts for the system. The technicians are required to be trained and individually certified by the

manufacture, the FACP model/series being installed. This training and certification must have occurred within the most recent 24 months, except that a NICET Level III certification will extend this to 36 months.

- F. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.
- G. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 - 2. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified AND FM Global-placarded addressable dedicated function system, for elevator recall and standpipe supervision.
- B. Automatic sensitivity control of certain smoke detectors.
- C. All components provided shall be listed for use with the selected system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
- E. Addressable Devices-General: All initiating devices shall be individually addressable. Addressable devices shall comply with the following requirements.
 - 1. Address Setting: Addressable devices shall provide an address-setting means.
 - 2. Connections: Addressable devices shall be connected to a Signaling Line Circuit (SLC) with two (2) wires.
 - 3. Operational Indications: Addressable initiation devices shall provide dual alarm and power LEDs. Both LEDs shall flash under normal condition, indicating that the device is operational and in regular communication with the control panel. Both LEDs shall be placed into steady illumination by the FACP to indicate that an alarm condition has been detected. The flashing mode operation of the detector LEDs shall be optional through the system field program. An output connection shall also be provided in the device base to connect an external remote alarm LED/.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. The system alarm LED shall flash and a local piezo-electric signal in the control panel shall sound. An 80-character minimum LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and it's locations with the protected premises.
 - 2. Transmit an alarm signal to the remote alarm receiving station.
 - 3. Recall elevators to primary or alternate recall floors.
 - 4. Record events in the system memory.
 - 5. Record events by the system printer.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. Valve supervisory switch.
 - 2. User disabling of zones or individual devices.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
 - 1. Open circuits, shorts, and grounds in designated circuits.
 - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 - 4. Loss of primary power at fire-alarm control unit.
 - 5. Ground or a single break in internal circuits of fire-alarm control unit.
 - 6. Abnormal ac voltage at fire-alarm control unit.
 - 7. Break in standby battery circuitry.
 - 8. Failure of battery charging.
 - 9. Abnormal position of any switch at fire-alarm control unit.
 - 10. Systems AC power trouble signal shall not be sent unless maintained for 1 to 3 hours. Provide additional relays as required for this purpose. Provide adjustable time delay for all other trouble signal prior to transmission.
- E. System Supervisory Signal Actions:
 - 1. Identify specific device initiating the event at fire-alarm control unit.
 - 2. Record the event on system printer.
 - 3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
 - 4. Provide immediate transmission of supervisory signals.

2.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 FIRE-ALARM CONTROL UNIT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 1. Notifier Intelligent Addressable Series.
- B. General Requirements for Fire-Alarm Control Unit:
 1. The system is to have multiple access levels, so owners authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. The process on how to do this must be included in the training required to be given to the owner's designated personnel, and must be part of the written documentation provided by the fire alarm equipment supplier.
 2. Digitized electronic signals shall employ check digits or multiple polling. In general, a single ground or open on any system signaling line circuit, or initiating device circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 3. Loss of power: alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
 4. The FACP must have an Alarm Silence switch, and be equipped with the subsequent alarm (alarm resound) feature.
 5. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
 6. Supervise all initiating and signaling circuits throughout the facility by way of connection to monitor and control modules.
 7. Visually and audibly, annunciate any trouble, supervisor or alarm condition on operator's terminals, panel display, and annunciators.
 8. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
 - d. The FACP shall be listed for connection to a central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
 9. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C. System Capacity and General Operation: The system shall have the following capacities and general operation modes.

1. The FACP shall provide, or be capable of expansion to 198 intelligent/addressable devices per Signaling Line Circuit (SLC) and 2048 annunciation points, minimum, per system.
- D. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
 3. The display shall provide four Light Emitting Diodes (LEDs) that will indicate the status of the following system perimeters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, AND SIGNAL SILENCE.
 4. The FACP shall be able to provide the following features:
 - a. Upload/download to PC computer
 - b. Charger rate control
 - c. Drift compensation
 - d. Automatic day/night sensitivity adjust
 - e. Device blink control
 - f. Pre-alarm control penal indication
 - g. Trouble reminder
 - h. NFPA 72 smoke detector sensitivity test
 - i. System status reports
 - j. Periodic detector test
 - k. Alarm verification, by device, with tally
 - l. Non-alarm module reporting
 - m. Block acknowledge
 - n. Smoke detector maintenance alert
 - o. Control-by-time
 5. Operators Control: Provide an operators interface which allows the following minimum functions. In addition, the operators interface shall support any other functions required for system control and/or operation.
 - a. Acknowledge (ACK/STEP) Switch
 - b. Signal Silence Switch
 - c. System Reset Switch
 - d. System Test Switch
 - e. Lamp Test Switch
 6. Air Handler Unit (AHU) Shutdown
 - a. A supervised "AHU Shutdown Defeat" switch must be provided in/adjacent to the FACP. The switch must cause a system "trouble" indication when it's placed in the off-normal ("Shutdown Defeated") position. This is to provide the owner with a convenient means to temporarily resume HVAC operation in the event an unwanted alarm will not clear, prior to arrival of the fire alarm service technician.
 - b. If the system included AHU shutdown, silencing the alarm (without resetting) must not reverse the shutdown. A supervised "AHU Shutdown Defeat" switch must be provided in the FACP. The switch must be labeled and its "Normal" position indicated.

E. Initiating-Device and Signaling-Line Circuits:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto a Class A Signaling Line Circuit (SLC) with no "T" taps.
2. Initiation Device Circuits (IDC) shall be wired Class A.
3. Pathway Survivability: Level 1.
4. Install no more than 50 addressable devices on each signaling-line circuit.
5. Serial Interfaces:
 - a. One dedicated RS 485 port for remote station operation using point ID DACT.
 - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - c. One RS 232 port for PC configuration.

F. The Central Processing Unit (CPU) shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the CPU.

1. The CPU shall contain and execute all control-by-event (including ANDing, ORing, NOTing, CROSSZONEing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure. The CPU shall also provide a real-time clock for time annotation of all system displays. The Time-of-Day and date shall not be lost if primary and secondary power supplies fail.
2. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

G. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

H. Elevator Recall:

1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.

I. Signaling Line Circuit (SLC) Interface Board: The FACP shall contain SLC interface boards as required to communicate with the SLC. Each SLC board shall monitor and control a minimum of 198 intelligent addressable devices. This includes 99 analog detectors (Ionization, Photoelectric, or Thermal) and 99 or control modules.

1. Each SLC interface board shall contain its own microprocessor, and shall be capable of operating in a local mode (and SLC input activates all or specific SLC outputs) in the event of a failure in the main CPU of the control panel. The SLC interface board shall not require any jumper cuts or address switch settings to initialize SLC loop operations. SLC interface boards shall provide power and communicate with all intelligent addressable detectors and modules connected to its SLC loop on a single pair of wires.
 2. Each SLC interface board shall receive analog information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular detector. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
- J. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.
1. Control panel shall be U.L. listed as meeting NFPA 75 sensitivity testing and maintenance requirements without the need for manually removing and testing each smoke detector. The control panel shall provide a display and a printed list of these sensitive measurements as a permanent record of required sensitivity testing. The system shall also annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to a gradual contamination, with an annunciation of the location of the smoke detector requiring service. If any, specialized equipment must be used to program any function of the smoke detector devices, then one must be furnished as part of the system.
 2. The system shall perform time based control functions including automatic changes of specified smoke detector sensitivity settings.
- K. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- L. Enclosures: The FACP shall be housed in a 3rd party listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion-protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).
- M. Power Supply: The FACP power supplied shall operate on 120 VAC, 60Hz and shall have a continuous rating adequate to power all equipment and functions in full alarm continuously. All modules and drives must be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage.
- N. The power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge.
- O. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

- P. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- Q. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 15 minutes of alarm upon a normal AC power failure. NAC circuits shall not exceed 75% of maximum current allowed.
- R. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Addressable pull stations shall, on command from the control panel, send data to the panel representing the state of manual switch. They shall use a key operated test-reset lock, and shall be designated so that after actual emergency operation, they cannot be restored to normal use except by use of a key. All pull stations shall be dual-action, have a positive, visual indication of operation and utilize a key type reset. Glass-break rods are not allowed.

2.6 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
 2. Detectors shall be two-wire type.
 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 6. Integral Visual-Indicating Light: LED type, indicating detector has operated.

7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Multiple levels of detection sensitivity for each sensor.
 - b. Sensitivity levels based on time of day.
8. Test Means: The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel when in the "test" condition.
9. Device Identification: Detectors shall store an internal identifying type code that the control panel shall use to identify the type of device. Device identifications shall be either ION, PHOTO, or THERMAL.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

1. Standpipe Valve Tamper Switches

2.9 ISOLATOR MODULE

- A. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop. Modules must be readily accessible (not above ceiling) and clearly labeled.
 - 1. Operation: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator Module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. The Isolator Module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an Isolator Module after it's normal operation.
 - 2. The Isolator Modules shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
 - 1. Preferred Fire Alarm Dialer: Notifier 411UD.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. Address of the supervisory signal.
 - 3. Address of the trouble-initiating device.
 - 4. Loss of ac supply.
 - 5. Loss of power.
 - 6. Low battery.
 - 7. Abnormal test signal.
 - 8. Communication bus failure.

- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 NETWORK COMMUNICATIONS

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

2.12 SYSTEM PRINTER

- A. Printer shall be listed and labeled as an integral part of fire-alarm system.
- B. Provide stand for printer.

2.13 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by device manufacturer.
 - 2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Connecting to Existing Equipment:
1. Connect new equipment to existing monitoring equipment at the supervising station.
 2. Expand, modify, and supplement existing monitoring equipment as necessary to extend existing monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- C. Surge Protection: The following protection against voltage transients and surges must be provided by the fire alarm equipment supplier, and installed by the electrical contractor.
1. On AC Input: A feed-through (not shut type) branch circuit transient suppressor such as Leviton 51020-WM-DN, or Di-Tech DTK-120S20A, or equivalent UL 1449 -2nd Edition.
 - a. For each AC power circuit that interfaces with fire alarm equipment install an AC suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1-inch diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of the suppressor in clipping fast rise time voltage transients.
 2. On DC Circuits Extending Outside the Building: Adjacent to the FACP, and also point of entry to outlying building, provide "pi"-type filter on each leg, consisting of a primary arrester, series impedance, and a fast-acting secondary arrester that clamps at 30v-40v. Some acceptable models: Simplex 2081-9067, Simplex 2081-9028, Transtector TSP8601, Ditek DTK 2MHLP24B Series, Citel America B280-24V, and Northern Technologies DLP-42. Submit data on others to the engineer for approval. UL 497B listing is normally a prerequisite for their consideration. Devices using only MOV active elements are not acceptable.
 - a. Install the surge arrester in a labeled enclosure.
- D. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g. detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.
- E. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
- F. Manual Fire-Alarm Boxes:
1. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- G. Smoke-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 2. Smooth ceiling spacing shall not exceed 30 feet.
 3. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
 4. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
 5. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- H. Unless suitably protected against dust, paint, etc., spot type smoke detectors shall not be installed until the final construction clean-up has been completed. In the event of contamination during construction, the detectors must be replaced by the contractor at no additional cost to the Owner. Covers supplied with smoke detector heads do not provide protection against heavy construction dust, spray paint, etc., and must not be used for that purpose. They are suitable only during final, minor cleanup or touchup operations.
- I. When programming the system, activate the automatic drift compensation feature for all spot-type smoke detectors. Systems with alarm verification are not to have this feature activated without written direction from the Owner's representative or the AHJ. Alarm verification must not be used with multi-sensor/multi-criteria detectors under any circumstances, as inadequate system response may result. Most applications of analog addressable smoke detectors do not require alarm verification to reduce nuisance alarms, as they are better able to discriminate between fire and common non-fire ambient events. A short operational test with normal occupancy can determine if transient ambient events are a problem.
- J. Set spot-type smoke detector sensitivities to normal/medium, unless directed otherwise by the design engineer/owner's rep. High sensitivity may be appropriate in relatively benign, clean environments such as art museums and libraries, to improve system response time without causing nuisance alarms.
- K. Addressable Interface Modules (Control and Monitor Modules)
1. Addressable interface modules (used to monitor all contact type initiating devices) must be located in conditioned space, unless they are tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed location.
 2. One module can serve as many as 3 standpipe system valve supervisory switches in a single space; otherwise provide one module per switch.
 3. Standpipe system supervisory circuits for monitoring valve position must cause distinct audible and visible indications at the FACP. The audible supervisory signal shall either be a 4" diameter bell or a pulsing piezoelectric alarm. Provide the following engraved label adjacent to the bell/alarm: "STANDPIPE STATUS ABNORMAL". If only valve position is supervised, provide an engraved label reading: "STANDPIPE VALVE CLOSED"
- L. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- M. Digital Alarm Communicator Transmitter:
1. The Contractor shall install conduit from a location next to the DACT for connection of the dialer to the main telecommunications room. A minimum 4x4x2.5-inch-deep hinged enclosure shall be installed within one (1) foot of the DACT and connected by a one (1) inch conduit. Cable termination will be performed by NC State.
- N. Provide isolation modules (or isolator bases) along each SLC (addressable loop). To minimize wiring fault impact, isolation modules shall be provided in all of the locations listed below. If

ceiling height <10 feet, isolator base type initiating devices are permitted to be used to satisfy any or all of the following

1. In or immediately adjacent to the FACP, at each end of the addressable loop. These two isolators must be in the same room and within 15 feet of the FACP.
 2. After each 20 initiating devices and control points on the addressable loop, or a lesser number where recommended by the manufacturer.
 3. For loops with 20 devices and control points, install an isolator at the approximate middle of the loop (in addition to those at the FACP).
 4. Near the point any addressable circuit extends outside the building, except for those attached to the building exterior walls and well sheltered by walkways.
 5. For loops covering more than one floor, install isolator at terminal cabinet on each floor (with additional isolators] on any floor with over 20 addresses).
 6. Each isolation module must be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling), and shown on as-built drawings.
- O. Print a complete System Status and Programming Report after the above steps have been done. This must include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector.
- P. Print a complete System Status and Programming Report after the above steps have been done. This must include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector.
- Q. Floor Plans with Device Numbers: A copy of the floor plans shall be provided in the control panel. A separate sheet shall be provided for each floor. Plans shall be reduced in size from engineering plans in order to fit on 11 x 14 sheets. All device addresses shall be clearly labeled on plans. Indicate locations of all cabinets, modules and end of line devices. Plans shall be bound in book form. Sheets shall be laminated. Provide legend for symbols. Provide holder for plan book in panel or in a locked box adjacent to panel keys to match panel. Provide label for box and book.
- R. Provide framed floor plans, mounted at the FACP. Plans shall show system devices with the unique device identification numbers indicated adjacent to each device. The identification numbers shall match those represent in the as-built drawings and those reported at the FACP.

3.3 WIRING

- A. Addressable loop (signaling line) circuits shall be wired type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACP. Acceptable cables include Atlas 228-18-1-ISTP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30 pf/ft. maximum between conductors, Belden 5320FJ acceptable if only FPL rating needed. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.
1. Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable.
- B. All wiring shall be color coded. All the circuits in the system shall be wired with AWG 14, minimum, stranded copper, THHN/THWN conductor, installed in metallic conduits. Color Coded

wires shall be in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:

- | | | |
|----|-------------------------------------|---------------------------------|
| 1. | Initiating Circuits, General | Red (+)/White (-) |
| 2. | Initiating Circuits, Smoke Only | -Violet (+)/Gray (-) |
| 3. | Signal Line Circuit cable | Red jacket with Red(+)/Black(-) |
| 4. | Alarm Indicating Appliance Circuits | - Blue (+)/Black (-) |
| 5. | AHU Shutdown Circuits | Yellow (+)/Brown (-) |

- C. Detection or alarm circuits must not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power must be properly separated from other circuits and the enclosure must have an appropriate warning label to alert service personnel to the potential hazard.
- D. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. "Wire nuts" and crimp splices will not be permitted. Permanent wire markers shall be used to identify all connections at the FACP and other control equipment, at power supplies, and in terminal cabinets. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
- E. All circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor. If building layout requires the terminal cabinet to be above a drop ceiling, its location must be clearly and permanently identified with a placard readable from floor. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
- F. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten (10) megohms, as verified with a megger. Provide advance notice to the Engineer of record of these tests.
- G. The system shall be electrically supervised for open or (+/-) ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.

3.4 PATHWAYS

- A. All fire alarm system wiring shall be in metal conduit or surface metal raceway.
 - 1. If cable size and the requirement to maintain a Class "A" loop on all Signaling Line Circuits cause conduit fill to exceed specified maximums for the 1/2" size, 3/4" raceway should be used.
 - 2. PVC conduit is permitted to be used underground, in concrete, and in locations approved by the AHJ.
- B. All conduits that penetrate outside walls from air-conditioned space must have internal sealing (duct-seal), to prevent condensation from infiltrating humid air.

3.5 AC POWER

- A. Systems are to be provided with a separate and independent source of emergency power. Switching to emergency power during alarm shall not cause signal drop-out. Batteries must meet the appropriate NFPA capacity requirements, with a 25% safety factor.
- B. The branch circuit breaker(s) supplying the system must be physically protected by panelboard lock or handle lock and each must be identified with a 1/4" permanent red dot applied to handle or exposed body area.
- C. Provide an engraved label at each fire alarm system control unit, and digital alarm communicator.

3.6 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Supervisory connections at valve supervisory switches.

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Basic operating instructions shall be framed and permanently mounted at the FACP. If the Owner concurs, they may instead be affixed to the inside of the FACP door. In addition, the NFPA 72 "Record of Completion" must either be kept in/at the FACP, or its location shall be permanently indicated there by an engraved label.
- C. Provide an engraved label inside the FACP identifying its 120 vac power source, as follows: panelboard location, panelboard identification, and branch circuit number.
- D. The exterior of all junction boxes containing fire alarm conductors shall be painted red; box interiors shall not be painted. Or box covers for junction boxes containing fire alarm conductors shall be painted red on both sides.
- E. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Labels shall be neatly applied block lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
- F. Identification of individual detectors is required. Assign each a unique number as follows, in sequence stating at the FACP: (Addressable Loop # _____ Device #). Show on the as-built plans, and also permanently mount on each detector's base so that it's readable standing on the floor below without having to remove the smoke detector. Exception; for detectors with housing (i.e. air duct), apply the identification to a suitable location on exterior of their housing. Device labels may not be affixed to the device. Identification labels must be printed labels with block lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.

- G. Loop 1 shall be assigned to the first floor devices and loop number shall increase with floor number. Device numbering starts in the same location on each floor and increase accordingly as circuit location increase.

3.8 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.9 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. System testing & certification
 - 1. Upon completion of the installation the Contractor and the Manufacturer's authorized installer together shall conduct a 100% performance test of each and every alarm initiating device for proper response. The system shall operate for 48 hours prior to start of test. The Contractor shall be present for the full 100% test.
 - 2. The A/E and owner must be given 7 days advance notice of the tests. All Audio Visual Device Testing shall be scheduled with the owner.
 - 3. 100% Test: The manufacturer or authorized distributor (by definition, "installer") must 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation must be part of the "System Status and Programming Report".
 - a. Upon completion of the installation and its programming, the installer's technician shall test every alarm initiating device for proper response and indication. Also, in coordination with the other building system contractors, all other system functions shall be verified. The engineer must be notified in advance of these 100% tests, to permit witnessing them if desired.
 - b. If AHU shutdown occurs for any alarm, then the matrix would indicate the specific control relay(s) for that function being commanded to operate for alarm from any initiating device.
 - c. The digital communicator shall be on-line and tested for proper communication to the receiving station.
 - d. All supervised circuits must also be tested to verify proper supervision. (Control circuits are among those required to be supervised.)
 - e. All testing described above shall be repeated in the event that subsequent software or wiring modifications are determined necessary to meet the requirements of the contract documents. Such re-testing shall be included as part of the base bid and provided at no additional cost to the Owner.
 - 4. Test Documentation: The installer must fill out and submit the following documentation to the owner, through the engineer, prior to the AHJ's system acceptance inspection:

- a. Written verification that this 100% system test was done with copy of print out generated during test.
 - b. The NFPA 72, "Record of Completion" Form. Use this form (no substitutes) to detail the system installation and also to certify that: (i) It was done per Code, and (ii) The Code required 100% test was performed. The fire alarm installer (manufacturer or authorized distributor's technician) must sign this form. If a representative of the AHJ, owner, or engineer witnesses the tests, in whole or in part, they must also sign the form to signify that fact only (annotating the form as needed to clarify their limited role).
 - c. The System Status and Programming Report described in NFPA 72. This must be generated on the day of the system acceptance inspection and shall include the measured sensitivity of each smoke detector.
 - d. The purpose of doing Item (c) on the day of the inspection is to assure detector sensitivity has not been affected by construction dust. Prudent contractors will have taken measures to prevent detector contamination during construction, and will also have had the system do a detector sensitivity test and printout prior to the day of the inspection, to make certain all devices are properly programmed and operating within their limits.
5. After completion of the 100% system test and submission of documentation as described above the installer is to request the engineer to set up an inspection. The system must operate for at least two days prior to this inspection. The responding Fire Department shall be notified of this, for pre-fire planning purposes. On local government projects, local fire authorities may also want to participate in system acceptance inspections. However, for State-owned property they have no inspection jurisdiction and, if present, are only to observe.
- D. Pre-final inspection: At the Owner's request and after passing the Designer's pre-final inspection, the Contractor and Manufacturer's authorized installer will conduct system test in the presence of the Owner and the Designer.
- E. Final inspection scheduling: Notify State Construction Office electrical inspector of final inspection date.
- F. Final inspection: The fire alarm system will be inspected, with portions of it functionally tested. This will normally include the use of appropriate means to simulate smoke for testing detectors, as well as functionally testing the system interface with building controls, fire extinguishing systems and any off-premises supervising station. This statistical (sampling) inspection is intended to assure that the contractor has properly installed the system and performed the 100% operational test as required by NFPA 72. The electrical contractor shall provide two-way radios, ladders, and any other materials needed for testing the system, including a suitable smoke source.
1. Test documentation shall be available for inspection by the State Construction Office during final acceptance.
 2. The test will be conducted entirely by the Contractor. A copy of the final database software must be presented to the Owner before this test. The software shall be loaded from these disks into the system in the presence of the Owner. The review will then be conducted using this software. Any deficiencies shall be recorded and corrected. After the items have been corrected, the system shall be tested again.
 - a. In the event of malfunctions or excessive nuisance alarms, the Contractor must take prompt corrective action. The Owner may require a repeat of the Contractor's 100% system test, or other inspections.

- b. Test Report: Upon successful completion of the Inspection and after the correction of all efficiencies, the manufacturer's authorized representative shall issue a test report to the Engineer and Owner, detailing and certifying the test.
 - c. System Acceptance: After successful completion of the Final Inspection and recommendation of the Engineer, the system will be accepted by the Owner. At this time the warranty period begins.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Final Acceptance, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.10 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Final Acceptance, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.11 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Final Acceptance, service agreement shall include software support for five years.
- C. Upgrade Service: At Final Acceptance, update software to latest version. Install and program software upgrades that become available within five years from date of Final Acceptance. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.
- D. The manufacturer, or authorized distributor, must maintain software version record on the system installed.

3.12 DEMONSTRATION

- A. The manufacturer's authorized representative must instruct the owner's designated employees in operation of the system, and in all required periodic maintenance. A minimum of 8 hours on-

site time will be allocated for this purpose. Two copies of a written, bound summary will be provided, for future reference.

1. Scheduling of training must be arranged to meet the Owner's schedule. Additional training shall be available at a cost to be mutually agreed upon by the Owner and the Contractor.
2. Training shall be in the Owner's provided classroom.
3. The training may not be waived, deleted or reduced in the number of hours required.
4. Training shall cover as minimum the following topics:
 - a. Preventive maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
 - b. Overall system concepts, capabilities, and functions. Training shall be in depth, so that the owner shall be able to take any device out of service and return any device to service without need of Manufacture's approval or assistance.
 - c. Explanation of all control functions, including training to program and operate the system software.
 - d. Methods and means of troubleshooting and replacement of all field wiring devices.
 - e. Methods and procedures for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
 - f. Manuals, drawings, and technical documentation. Actual system software used for training shall be provided in digital form and shall be left with the Owner at the completion of training for the Owner's use in the future.
5. A ground fault and an isolation problem shall be introduced by the vendor into the system. The employees shall then find the ground fault and the isolation problem.
6. An NFPA 72 "Record of Completion" form shall be provided and the employees shall fill out the forms which shall be checked by the vendor for proper use of the form.
7. The written testing for how to perform services on a panel shall be given during the last 4-hour session with the employees.
8. The vendors shall witness the owner's "trained" employees, train other employees and correct any mistakes made during the training session. This is expected to occur during the 2nd four-hour session.

END OF SECTION 284621.11

SECTION 311000 – SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping or sealing, and removing/relocating site utilities.
 - 7. Temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises in a location approved by the Owner.
- C. Utility Locator Service: Notify One Call for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- E. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- H. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. General: Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
- C. Excavate for and remove underground utilities indicated to be removed.
- D. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods for grubbing within protection zones.
 - 4. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 1. Limit height of topsoil stockpiles to 72 inches.
 2. Do not stockpile topsoil within protection zones.
 3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, and aggregate base as indicated.
 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, and pavements.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase course and base course (if specified) for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

- B. Related Sections:

1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
3. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 UNIT PRICES (NOT USED)

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles.
 - 2. Geogrids.
 - 3. Warning tapes.
- B. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Geotextile: 12 by 12 inches.
 - 2. Geogrid: 12 by 12 inches.
 - 3. Warning Tape: 12 inches long; of each color.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
 2. Laboratory compaction curve according to ASTM D 698.
- C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- B. Preexcavation Conference: Conduct conference with Owner at Project site.

1.8 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: N/A
- C. Utility Locator Service: Notify "One Call" for area where Project is located before beginning earth moving operations.
- D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, indicated on Drawings are in place and stable.
- E. Do not commence earth moving operations until plant-protection measures are in place.
- F. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- G. Do not direct vehicle or equipment exhaust towards protection zones.
- H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 1. Liquid Limit: 35
 - 2. Plasticity Index: 9
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- I. Sand: ASTM C 33; fine aggregate.
- J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: 205 lbf; ASTM D 4632.

3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 500 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 80 sieve, maximum; ASTM D 4751.
7. Permittivity: 1.4 per second, minimum; ASTM D 4491.
8. UV Stability: 70 percent; ASTM D 4355.

2.3 GEOGRIDS

- A. A synthetic planar structure by a regular network of tensile strength elements with apertures of large enough size to allow interlocking with layered soil and stone; complying with ASTM D 6637 and D 6992; Flexible Geogrids made from textile weavings (polyester, fiberglass) with a flexible rigidity < 1000 g-cm (ASTM D 1388) shall not be considered for roadways or structural foundation layers.
- B. A minimum loose fill of 6-inches base or subbase material shall be placed over the geogrid before tracked construction vehicles travel over the geogrid.
- C. Do not expose to sunlight for a longer period longer than recommended by the manufacturer.

2.4 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored to comply with industry standards unless local authority has different practices and/or requirements.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with industry standards unless local authority has different practices and/or requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Explosives are not permitted.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Reference Structural Drawings and/or Specifications.
 - 2. Reference Geotechnical Report for this project's geotechnical specifications.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 - 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
 - B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 1. Clearance: 12 inches each side of pipe or conduit.
 - C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
 - D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
 - E. Trench Bracing
 1. Properly brace, sheet, and support trench walls as soil conditions indicate and in strict accordance with all pertinent laws and OSHA regulations. Provide adequate bracing and shoring to protect adjacent improvements.
 - F. Trenches in Tree- and Plant-Protection Zones:
 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
- 3.8 EXCAVATION FOR ELEVATOR CYLINDER
- A. Drill well hole plumb in elevator pit to accommodate installation of elevator-cylinder assembly. Coordinate with applicable requirements for diameter and tolerances in Section 142105 "Electric Traction Elevators".
 - B. Provide well casing as necessary to retain walls of well hole.

3.9 SUBGRADE INSPECTION

- A. Notify Geotechnical Engineer when excavations have reached required subgrade.
- B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Geotechnical Engineer, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.

6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil.
- D. Backfill voids with satisfactory soil while removing shoring and bracing.
- E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.14 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
1. Under grass and planted areas, use satisfactory soil material.
 2. Under walks and pavements, use satisfactory soil material.
 3. Under steps and ramps, use engineered fill.
 4. Under building slabs, use engineered fill.
 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.15 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent.
 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.17 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 1. Turf or Unpaved Areas: Plus or minus 2 inches.
 2. Walks: Plus or minus 1 inch.
 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course (if specified) on subgrades free of mud, frost, snow, or ice.

- B. On prepared subgrade, place subbase course and base course (if specified) under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase course and base course (if specified) to required crown elevations and cross-slope grades.
 - 4. Place subbase course and base course (if specified) 6 inches or less in compacted thickness in a single layer.
 - 5. Place subbase course and base course (if specified) that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 6. Compact subbase course and base course (if specified) at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 - 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

- A. Special Inspections: The Contractor will engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material and maximum lift thickness comply with requirements.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
 - 4. For additional Special Inspection requirements, please refer to the complete Architectural Plan Set to include but not limited to Structural Engineering, and Mechanical, Electrical, and Plumbing Engineering.
- B. Testing Agency: The Contractor will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by the Geotechnical Engineer.
- E. Testing agency will test compaction of soils, if required, in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2500 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 100 feet or less of trench length, but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes construction dewatering.
- B. Related Requirements:
 - 1. Section 013233 "Photographic Documentation" for recording preexisting conditions and dewatering system progress.
 - 2. Section 312000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.
 - 3. Section 334600 "Subdrainage" for permanent foundation wall, underfloor, and footing drainage.

1.3 ALLOWANCES (NOT USED)

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
 - 3. Review geotechnical report.
 - 4. Review proposed site clearing and excavations.
 - 5. Review existing utilities and subsurface conditions.
 - 6. Review observation and monitoring of dewatering system.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.
 - 1. Include plans, elevations, sections, and details.
 - 2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.

3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Existing Conditions: Using photographs and/or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.
- D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

1.8 FIELD CONDITIONS

- A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.
 1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
 2. The geotechnical report is included in this Project Manual.
- B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 5. Remove dewatering system when no longer required for construction.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing," during dewatering operations.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
1. Space well points or wells at intervals required to provide sufficient dewatering.
 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

- B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
 - 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 3. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

- A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.
 - 1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
 - 2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
 - 3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Survey-Work Benchmarks: Resurvey benchmarks regularly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect and Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.
- C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

- D. Prepare reports of observations.

3.5 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 312319

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Requirements:
 - 1. Section 013233 "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
 - 2. Section 312000 "Earth Moving" for excavating and backfilling and for controlling surface-water runoff and ponding.
 - 3. Section 312319 "Dewatering" for dewatering excavations.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review geotechnical report.
 - 2. Review existing utilities and subsurface conditions.
 - 3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
 - 4. Review proposed excavations.
 - 5. Review proposed equipment.
 - 6. Review monitoring of excavation support and protection system.
 - 7. Review coordination with waterproofing.
 - 8. Review abandonment or removal of excavation support and protection system.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.
- B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.
 - 1. Include plans, elevations, sections, and details.

2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
3. Indicate type and location of waterproofing.
4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Existing Conditions: Using photographs and/or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.
- D. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of utility.
 2. Do not proceed with interruption of utility without Architect's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
 2. The geotechnical report is referenced elsewhere in Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.
 - 1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

2.2 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
 - 1. Corners: Roll-formed corner shape with continuous interlock.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
- E. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- H. Tiebacks: Steel bars, ASTM A 722/A 722M.
- I. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.
- B. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Drill, install, grout, and tension tiebacks.
- B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.
- C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
 - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.7 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
 - 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
 - 2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
 - 3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

SECTION 31 66 50 – RIGID INCLUSIONS

PART 1 - GENERAL

1.1 INTRODUCTION

The work under this Section shall consist of the construction of Rigid Inclusions (RI) as discussed in the Plans and Specifications for the Project, as well as related quality control testing and performance testing. The Rigid Inclusions (RI) Contractor shall furnish all supervision, labor, material, equipment, and related services necessary to perform the work.

- A. Rigid Inclusions are columns of grout used to reinforce the ground to increase bearing capacity and reduce settlement of a structure or embankment. Rigid Inclusions are constructed with an auger displacement tool or vibrated pipe tool that displaces soil laterally, producing very little spoils.
- B. Suitable Soils: Rigid Inclusions are typically utilized in weak or compressible soils that require additional reinforcement to increase bearing capacity and reduce settlement. Rigid Inclusions are also effective in contaminated soils because very little spoil is created during the installation process.
- C. Applications: Rigid Inclusions are used in many applications. Examples of structures previously constructed on Rigid Inclusions include: warehouses, multi-level condominiums, commercial retail or office space, roadway embankments, tanks, retaining structures, and parking structures.

1.2 INTENT

The intent of the Rigid Inclusions program specified herein is to aid in supporting the applied loads and control the settlement to less than the specified maximum values.

1.3 STANDARDS AND REFERENCES

All material testing to determine specification compliance will be provided by an independent testing agency retained by the Owner. Load testing to be performed by the RI Contractor.

- A. Applicable Standards: The most recent version of the following testing methods or standards shall/may be employed:
 - 1. ASTM C31: Standard Practice for Making and Curing Cement Test Specimens in the Field.
 - 2. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 3. ASTM C94: Standard Specification for Ready-Mixed Concrete.
 - 4. ASTM C143: Standard Test Method for Slump of Hydraulic-Cement Concrete.
 - 5. ASTM C150: Standard Specification for Portland Cement.
 - 6. ASTM C172: Standard Practice for Sampling Freshly Mixed Concrete.
 - 7. ASTM C1064: Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
 - 8. ASTM D1143: Standard Test Methods for Piles Under Static Axial Compressive Load.

9. ASTM D1194: Standard Test Method for Bearing Capacity of Soil for Static Load and Spread Footings.
10. ASTM D3689: Standard Test Methods for Deep Foundations Under Static Axial Tensile Load.

B. Reference Documents: Reference documents to be used by the RI Contractor shall include:

1. This specification.
2. Project Drawings.
3. Project geotechnical report entitled: Geotechnical Engineering Report, UNCW Parking Deck Wilmington, New Hanover County, North Carolina, ECS Project Number # 22:27313R2, dated February 5, 2019, prepared by ECS Southeast, LLP.

1.4 DEFINITIONS

The key terms used in this specification are defined below.

- A. Rigid Inclusions (RIs): Ground Improvement by the use of Rigid Inclusions typically uses grout elements to reinforce weak or compressible strata; resulting in increased bearing capacity and reduced settlement.
- B. Displacement Tools: Auger or Pipe tools specially designed to displace soil laterally while advancing or retracting the tool. The displacement tool creates very little spoil.
- C. Field Quality Control Representative (FQCR): The individual, generally titled Superintendent or Field Engineer, given specific inspection and testing tasks identified in this specification.

1.5 SCOPE OF WORK

In general, the scope of the work including the main tasks required to perform the work.

- A. General Description: The work shall consist of construction, monitoring, and testing of RIs as identified in this specification within the limits indicated on the Foundation Plan, drawing number S-100, to meet the acceptance criteria presented in Section 3.5 of these specifications.
- B. Overview of Tasks: In connection with the RI program, as shown on the drawings, the RI Contractor shall provide all labor, materials, and equipment to accomplish the following items of work:
 1. Furnish and convey grout to RI locations.
 2. Construction of RIs to the lines, grades, and criteria detailed on the approved RI Shop Drawings.
 3. Monitor installation parameters utilizing an on-board electronic Data Acquisition System.
 4. Trim RI tops to design elevations and backfill open hole with material designated by RI Design Engineer.
 5. Complete QA/QC program.
- C. Performance Responsibility: It shall be the RI Contractor's responsibility to determine and implement the systems to ensure that specified criteria is achieved.

1. RI design shall be sealed by a Professional Engineer in the State of North Carolina, and compliance with the performance specifications (provided by Structural Engineer of Record) shall be the responsibility of the RI Contractor.
2. RI design shall provide details and construction requirements for the Load Transfer Platform.

D. Performance Criteria:

1. Provide the specified bearing pressure/capacity of 6,000 psf at the foundation.
2. Limit total static settlement of the foundation to 1 inch during service conditions, as described in the drawings and Geotechnical Report.
3. Limit differential static settlement of the foundation to 1/2 inches during service conditions, as described in the drawings and Geotechnical Report.

1.6 SUBMITTALS

This section details all submittals required with the bid, prior to field work, during production work, and after the work is completed.

A. Bid Time Submittals: The following shall be submitted to the Owner's representative by the RI Contractor with the bid documents:

1. A list of at least five previously completed projects of similar scope and purpose for approval by the Owner's representative. The list shall include a description of the project, relative size, and contact person with phone number.

B. Pre-Field Work Submittals: The following shall be submitted to the Owner's representative by the RI Contractor two weeks prior to the start of the work:

1. Resumes of the management, supervisory, and key personnel for approval by the Owner's representative.
2. A ground improvement design based on information contained in the project Geotechnical Report, sealed by an engineer licensed in the state of the work to be performed, that demonstrates that the program achieves the specified performance criteria provided in Section 1.5 of these specifications.
3. A ground improvement QA plan, as detailed in Section 3.4 of these specifications.
4. Work procedures and Quality Control criteria.
5. Load test details, general test procedures, and loading increments.
6. A shop drawing for review indicating the spacing, location, and depth or installation criteria of RIs to achieve the criteria outlined in this specification.
7. Schedule of values.
8. Grout mix design.

C. During Production Submittals: The following shall be submitted to the Owner's representative by the RI Contractor during the work:

1. Accurate daily records of all RIs constructed as detailed in Section 2.1.C.1 below.
2. Any change in the predetermined RI program necessitated by a change in the subsurface conditions.
3. Load test results, analysis of the data, and recommendations for design parameters prepared by an engineer licensed in the state of the work.

- D. Closeout Submittal: The following shall be submitted to the Owner's representative by the RI Contractor within 15 business days of the completion of the RI work.
1. As-built drawings documenting the as-built conditions of the RI work.
 2. A warranty document good for one year from the date of RI work completion.

1.7 QUALIFICATIONS

The qualifications for the RI Specialty Contractor and personnel are defined below.

- A. RI Specialty Contractor: The RI program shall be performed by a specialist RI Contractor with at least five years of documented experience in RI construction. Hayward Baker, Inc. is a preapproved RI Contractor.
- B. Personnel: The RI Contractor shall provide experience management, supervisory, and key personnel as required to implement the RI program, as follows:
1. The project manager shall have at least three years of experience in RI construction, with at least the last two years in the full-time employment of the RI Contractor.
 2. The superintendent shall have at least three years of experience in RI installation.

PART 2 - EQUIPMENT AND MATERIALS

2.1 EQUIPMENT

The equipment used to perform the RI construction consists of the common construction equipment, specialty equipment, and data acquisition system required to perform this work.

- A. General: The RI Contractor shall supply equipment in good operating condition capable of performing the work specified herein.
- B. Specific Equipment Capabilities: The choice of installation rig is largely dictated by site conditions and is left to the experience of the RI Contractor. The equipment shall be able to apply sufficient force and/or torque to penetrate to the design depth based on the subsurface conditions represented in the project Geotechnical Report. The installation tool shall be of sufficient length to reach the required depth. Grout shall be placed using suitable pumping equipment and through suitable tubing. The system shall have means of determining the volume of grout delivered to the tooling at any time during construction.
- C. Equipment Instrumentation: The RI Contractor shall provide gauges or other instrumentation (measuring devices) to provide real time measurement and recording through a data acquisition system of:
1. RI number, start/finish time of installation, rate of penetration, crowd pressure and/or torque, depth of treatment (or tip elevation), neat volume based on depth of treatment, and volume of grout placed.
- D. Communication Equipment: An adequate communication system shall be maintained between the RI rig operator and the grout pump operator.

2.2 MATERIALS

The materials incorporated in this work shall meet the following minimum standards:

- A. Portland Cement: Conforming to the ASTM Standard C150/C150M.
- B. Fluidifier (if required): Shall be a compound possessing characteristics which will increase the fluidity of the mixture, acting as water reducing agent and retardant.
- C. Water: Shall be potable, fresh, clean, and free of sewage, oil, acid, alkali, salts, or organic matter.
- D. Fine and Course Aggregate: Fine and coarse aggregate shall conform to the requirements of the RI Design Engineer.
- E. Reinforcing Steel: If required, reinforcing steel shall conform to the requirements of the RI Design Engineer.
- F. Geogrid/Geotextile: Geogrid (if required per the RI Design Engineer) shall conform to and be installed in accordance with the manufacture's specifications and guidelines, as per the details in the drawings.
- G. Grout Mixes: Grout for Rigid Inclusions shall consist of Portland cement, sand, and water, and may also contain coarse aggregate, a mineral admixture, and/or approved fluidifier. The components shall be proportioned and mixed to produce a grout capable of maintaining the solids in suspension, minimizing bleed, and being pumped without difficulty. The required grout strength shall be determined by the RI Design Engineer.

PART 3 - EXECUTION

3.1 SITE VISIT

Site visits are necessary in order to be aware of conditions at the work site.

- A. Pre-Bid Site Visit: Prior to submitting a bid price for the rigid inclusion program, the RI Contractor shall visit the site during the project pre-bid meeting to identify readily visible conditions in order to account for them in the bid.
- B. Existing Structures: Prior to initiating work, a condition survey of structures in the immediate vicinity of the work shall be performed by the Owner/General Contractor to determine that the conditions are safe to perform the specified work. The structure(s) must be examined prior to initiating work to document preexisting cracks/damage. The structure(s) must also be monitored for movement during any work within 15 feet of the structure(s). The work shall be stopped and the engineer notified of any negative structural impacts that are observed (settlement, increase in crack width, etc).

3.2 SITE PREPARATION

The following shall be performed by the General Contractor in support of the RI Contractor:

- A. Removal of all surface or subsurface topsoil, brush, organic material, and other unacceptable material in accordance with the requirements of the contract documents. Removal of any surface or subsurface obstructions to the RI work.
- B. Site shall be graded to an agreed working elevation. A dry, level, and stable working platform shall be provided and maintained throughout the work. Platform stability should be evaluated and certified by the Owner's Geotechnical Engineer and the General Contractor, based on equipment information provided by the RI Contractor.
- C. Provision of all-weather access and maintenance thereof for the RI Contractor's equipment and workforce, and for delivery of materials to the worksite.
- D. Horizontal and vertical survey control and survey layout of building corners, grid lines, footing locations, embankment limits, utilities etc., for reference by the RI Contractor for layout and performance of the RI work.

3.3 RIGID INCLUSIONS

Rigid Inclusions shall be constructed in accordance with the approved design and shop drawings.

- A. Procedures: Rigid inclusions shall be constructed at the locations shown in the RI layout drawing.
 - 1. The RI tool shall be advanced to design depth or tool refusal. During grouting the RI tool shall be filled with a grout volume adequate to maintain a positive grout head for the RI withdrawal of the tool. Grout is placed fully to the final RI cutoff elevation.
 - 2. The grout shall be supplied at a sufficient rate during tool withdrawal to ensure that a continuous element of the full specified cross-section is formed, free of debris. The depth of the tool and volume of grout shall be measured and recorded for each element. If the grout placement in any element cannot be completed as described above, then the element shall be re-penetrated before grout has hardened and grout placed to the final RI cutoff elevation or the RI shall be completely replaced.
- B. Installation criteria: Installation criteria shall be as follows:
 - 1. Location of RIs: The RIs shall be located within 6 inches of the planned horizontal location unless otherwise approved by the RI Design Engineer.
 - 2. Obstructions: Obstructions encountered during advancement of the RI tool that will prevent installation to the design depth or cause the RI tool to redirect from its design location during installation, shall be removed.

Obstructions include, but are not limited to: boulders, timbers, concrete, bricks, utility lines, etc. that prevent advancement of the RI tool to the required depth or cause the RI tool to redirect from the design location. Dense natural soil, natural rock, or weathered rock shall not be considered obstructions. The RI Design Engineer shall be notified within 24 hours of any obstructions or unexpected early refusal to verify the revised location and/or depth are acceptable.
 - 3. Depth of work: The RIs shall be constructed to a minimum depth as shown on the approved shop drawings, or to the specified refusal criteria; whichever is greater. RI installation rigs are equipped with instrumentation to measure, display, and record the tool penetration rate versus depth.

4. Diameter of RIs: The RIs shall be constructed to the diameter shown on the project drawings or the approved shop drawings.
 5. Refusal Criteria: Refusal of the RI tool is defined as a reduction in the penetration rate during installation, and shall be determined by competent field personnel and the RI Design Engineer. Specific refusal criteria will depend on project geology and equipment used, and will be established at the start of fieldwork.
 6. Limits of work: As shown on the project drawings.
- C. Completion: Prior to completion of the RI program, the following shall be completed at each RI location.
1. Grout shall be cast to the final RI cutoff elevation unless otherwise specified. If necessary, to protect Rigid Inclusions from damage due to subsequent construction activities, elements shall be dipped out prior to initial set and backfilled with gravel or granular fill. Alternatively, a steel reinforcing member may be installed into the upper portion of the element to protect against damage.
- D. Subsequent Construction: A Load Transfer Platform (LTP) shall be constructed by the General Contractor over the RI heads to transfer the design loads to the elements.
1. The LTP shall be constructed of a specified granular material and may be reinforced with one or more layers of biaxial geogrid and/or geotextile as shown in the approved RI design and shop drawings.

Construction of the LTP shall not commence until the compressive strength of the grout has reached a value provided by the RI Design Engineer. LTP material, lift thickness, and compaction shall conform to the approved RI design and shop drawings. Testing requirements shall be equal to those required by the project Geotechnical Engineer of Record. Materials shall conform to those specified in the approved RI design and shop drawings.

Construction of the LTP shall be installed in a manner as to avoid direct contact with cured rigid inclusions. The RI Contractor and RI Design Engineer shall be notified if any heavy machinery makes contact with a cured RI during LTP construction or excessive rutting is experienced adjacent to cured RIs. Replacement RIs may be required if RIs are damaged during LTP construction. Cost of construction of the replacement RI shall be borne by the Owner or LTP installer.

2. The Owner's inspector shall monitor LTP construction and foundation construction. Compaction shall be performed and accomplished as specified in the contract drawings for structural fill or LTP construction. Reinforcement and concrete placement shall be performed in a timely manner so that no degradation of the bearing surface occurs. In the case of foundation construction, if foundation concrete cannot be placed on the same day that excavation takes place, then a minimum 3-inch-thick mud mat shall be placed immediately following approval of the footing excavation and LTP construction.

3.4 QUALITY CONTROL

The details of the quality control program are as follows:

- A. Oversight: All RI construction shall be performed under the inspection of the FQCR.

- B. Monitoring and logging of all RI operations for all test areas and production work shall be done under the supervision of the FQCR.
- C. A test program to determine specification and design compliance shall be determined by the RI Designer of Record. This test program shall be implemented in accordance with the approved design submittal.
- D. A production quality control program shall be included in the workplan submittal describing sampling and testing procedures, frequency, and performance criteria to ensure that all construction materials are meeting the design requirements.
- E. Layout of rigid inclusions is the responsibility of the RI Contractor, based on sufficient specified layout or control points provided by the General Contractor.

3.5 ACCEPTANCE MEASUREMENTS, TESTING, AND CRITERIA

The acceptance of the RI work shall be solely based on the following:

- A. The performance verification test program meets the requirements established by the RI Designer of Record.
- B. All Rigid inclusions are installed per the approved design and shop drawings.
- C. All Rigid Inclusions are monitored in accordance with the quality control plan established by the RI Designer of Record.
- D. A Rigid Inclusion may be rejected if it is installed in an incorrect location or the location exceeds the specified tolerance stated in Section 3.3B. If a Rigid Inclusion is rejected, the RI Contractor shall replace the RI. Replacement of the RI may be avoided if alternate remedial procedures are approved by the RI Design Engineer.

3.6 RESTRICTIONS

The following restrictions apply to the performance of the work.

- A. Permits and Regulations: The Owner or General Contractor shall be responsible for obtaining any State and Municipal permits (if required).
- B. Utilities and Obstructions: The General Contractor shall be responsible for the precise delineation of all above and below ground utilities and obstructions, and shall accurately mark their layout at the site, as referenced in Section 3.02C. Utilities which cannot be removed shall be exposed and made known to the RI Contractor prior to installation of adjacent RIs. When necessary, the General Contractor shall pot hole RI locations to verify no utilities are present prior to RI installation.
- C. Other Restrictions: Coordinate with General Contractor for UNCW Campus restrictions.

END OF SECTION 316650

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SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.

B. Related Requirements:

1. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.2 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each paving material.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.
- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Technical Standards and Specifications Manual of the City of Wilmington for asphalt paving work.
1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone or crushed gravel.
- B. Fine Aggregate: ASTM D 1073 sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320, PG 64-22
- B. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

2.4 MIXES

- A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 10 percent or more than 15 percent by weight.
 - 1. Surface Course Limit: Recycled content no more than 10 percent by weight.
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - 2. Surface Course: S-9.5B

PART 3 - EXECUTION

3.1 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove

excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
 - 1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.2 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Spread mix at a minimum temperature of 250 deg F.
 - 2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.5 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Surface Course: Plus 1/4 inch.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Surface Course: 1/8 inch
 - 2. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Replace and compact hot-mix asphalt where core tests were taken.
- C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.8 WASTE HANDLING

- A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Driveways.
2. Walks.
3. Curbs and gutters.
4. Dumpster pad.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301 unless otherwise indicated.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.
2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.

1.4 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
 - 1. 6 x 6 – W1.4/W1.4
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
 - 1. 6 x 6 – W1.4/W1.4

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C 150, gray portland cement Type I. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.
- C. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: Potable and complying with ASTM C 94/C 94M.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
- G. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Color: As indicated by manufacturer's designation.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.5 RELATED MATERIALS

- A. Joint Fillers: [ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.6 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.
 - 1. Color: As indicated

2.7 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete
 - 1. Color: Gray.
 - 2. Dowels: Galvanized steel, 3/4 inch in diameter, 10-inch minimum length.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 with the following properties:
 - 1. Compressive Strength (28 Days): As shown on drawings
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch
 - 4. Air Content: 6 percent plus or minus 1.5 percent.

- B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.

- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, placing, and consolidating concrete.
- C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- D. Screed paving surface with a straightedge and strike off.
- E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
 - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
- C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions.
 - 1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
 - 2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these.

3.8 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 3/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/2 inch.
 - 4. Joint Spacing: 3 inches.
 - 5. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 6. Joint Width: Plus 1/8 inch, no minus.

3.9 PAVEMENT MARKING

- A. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.10 WHEEL STOPS

- A. Securely attach wheel stops to paving with not less than two galvanized-steel dowels located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Cold-applied, fuel-resistant joint sealants.
4. Hot-applied, fuel-resistant joint sealants.
5. Joint-sealant backer materials.
6. Primers.

- B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing non-traffic and traffic joints in locations not specified in this Section.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg. F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Non-sag, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type NS.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crafcro Inc.; RoadSaver Silicone.
 - b. Dow Corning Corporation; 888.
 - c. Pecora Corporation; 301 NS.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type SL.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crafcro Inc.; RoadSaver Silicone SL.
 - b. Dow Corning Corporation; 890-SL.
 - c. Pecora Corporation; 300 SL.
- C. Multicomponent, Non-sag, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Meadows, W.R., Inc.; Pourthane NS.

2.3 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I, II, or III.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crafcro Inc.; RoadSaver 222.
 - b. Meadows, W.R., Inc.; Sealtight 3405.
 - c. Right Pointe;.
- B. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type IV.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crafco Inc.; RoadSaver 231.
- b. Meadows, W.R., Inc.; Sealtight 3405M.

2.4 COLD-APPLIED, FUEL-RESISTANT JOINT SEALANTS

- A. Fuel-Resistant, Single-Component, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. BASF Building Systems; Sonomeric 1.

2.5 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Non-staining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.6 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless requirements that are more stringent apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
 - 1. Place joint sealants so they fully contact joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Non-sag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
 - 1. Remove excess joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Joints within concrete paving.
 - 1. Joint Location:
 - a. Expansion and isolation joints in concrete paving.
 - b. Contraction joints in concrete paving.
 - c. Other joints as indicated.
 - 2. Joint Sealant: Single-component, non-sag, silicone joint sealant or Multicomponent, non-sag, urethane, elastomeric joint sealant.
 - 3. Joint-Sealant Color: Manufacturer's standard.
- B. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving.
 - 1. Joint Location:
 - a. Joints between concrete and asphalt paving.
 - b. Joints between concrete curbs and asphalt paving.
 - c. Other joints as indicated.
 - 2. Joint Sealant: Hot-applied, single-component joint sealant.
 - 3. Joint-Sealant Color: Manufacturer's standard.
- C. Joint-Sealant Application: Fuel-resistant joints within concrete paving.
 - 1. Joint Location:
 - a. Expansion and isolation joints in concrete paving.
 - b. Contraction joints in concrete paving.
 - c. Other joints as indicated.
 - 2. Joint Sealant: Fuel-resistant, single-component, pourable, modified-urethane, elastomeric joint sealant.
 - 3. Joint-Sealant Color: Manufacturer's standard.

END OF SECTION 321373

SECTION 321713 - PARKING BUMPERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wheel stops.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

- A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.
 - 1. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inch diameter, 10-inch minimum length.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.
- B. Install wheel stops in bed of adhesive before anchoring.
- C. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer.

END OF SECTION 321713

SECTION 321726 - TACTILE WARNING SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place detectable warning tiles.
- B. Related Requirements:
 - 1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of exposed finish requiring color selection.
- C. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Adhesive Application:
 - 1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.
- C. Weather Limitations for Mortar and Grout:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
 - a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set unit pavers within 1 minute of spreading setting-bed mortar.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering and wear.
 - b. Separation or delamination of materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

- A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for tactile warning surfaces.
 - 1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

- B. Source Limitations: Obtain each type of tactile warning surfacing, joint material, setting material, anchor, and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. Access Products, Inc.
- b. ACO Polymer Products, Inc.
- c. ADA Solutions, Inc.
- d. Advanced Surface Systems, LLC.
- e. AlertTile; a division of Cape Fear Systems, II, LLC.
- f. Arcis Corp.
- g. Armorcast Products Co.
- h. Detectable Warning Systems, Inc.
- i. Detectile, Inc.
- j. Engineered Plastics, Inc.; Armor-Tile.
- k. Mingo Products, Inc.
- l. StrongGo Industries, LLC.
- m. Transpo Industries, Inc.

- 2. Material: Molded glass- and carbon-fiber-reinforced polyester.
- 3. Color: As selected by Architect from manufacturer's full line.
- 4. Shapes and Sizes:

- a. Rectangular panel, 24 by 60 inches.

- 5. Dome Spacing and Configuration: Manufacturer's standard compliant spacing in manufacturer's standard pattern.

- 6. Mounting:

- a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.

2.3 ACCESSORIES

- A. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

- A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles:
 - 1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.
 - 2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
 - 3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.
 - 4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
 - 5. Clean tiles using methods recommended in writing by manufacturer.

3.4 CLEANING AND PROTECTION

- A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.
- B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 321726

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Chain-link fences.
 - 2. Swing gates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Accessories: Privacy slats.
 - d. Gates and hardware.
- B. Shop Drawings: For each type of fence and gate assembly.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include accessories, hardware, gate operation, and operational clearances.
- C. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:
 - 1. Polymer-Coated Components: In 6-inch (150-mm) lengths for components and on full-sized units for accessories.

1.4 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to existing structures. Verify dimensions by field measurements.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Faulty operation of gate hardware.
 - 2. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
 - 1. Fabric Height: As indicated on Drawings.
 - 2. Steel Wire for Fabric: Wire diameter of 0.192 inch (4.88 mm).
 - a. Mesh Size: 2 inches (50 mm).
 - b. Polymer-Coated Fabric: ASTM F668, Class 1 over zinc-coated steel wire.
 - c. Color: Black
 - d. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
 - 3. Selvage: Knuckled at both selvages.

2.2 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:
 - 1. Fence Height: As indicated on Drawings.
 - 2. Light-Industrial-Strength Material: Group IC-L, round steel pipe, electric-resistance-welded pipe.
 - a. Line Post: 1.9 inches (48 mm) in diameter.
 - b. End, Corner, and Pull Posts: 2.375 inches (60 mm).
 - 3. Horizontal Framework Members: Intermediate rails according to ASTM F1043.
 - a. Top Rail: 1.66 inches (42 mm) in diameter.

4. Polymer coating over metallic coating.
 - a. Color: Black.

2.3 TENSION WIRE

- A. Polymer-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, tension wire according to ASTM F1664, Class 1 over zinc-coated steel wire.
 1. Color: Black.

2.4 SWING GATES

- A. General: ASTM F900 for gate posts and single and double swing gate types.
 1. Gate Leaf Width: As indicated.
 2. Framework Member Sizes and Strength: Based on gate fabric height as indicated.
- B. Pipe and Tubing:
 1. Gate Posts: Round tubular steel.
 2. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded or assembled with corner fittings.
- D. Hardware:
 1. Hinges: 180-degree inward swing.
 2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.

2.5 FITTINGS

- A. Provide fittings according to ASTM F626.
- B. Post Caps: Provide for each post.
 1. Provide line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches (152 mm) long.
 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate rails to posts.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel, length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Tie Wires, Clips, and Fasteners: According to ASTM F626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
 - a. Hot-Dip Galvanized Steel: 0.106-inch- (2.69-mm-) diameter wire.

H. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. (366 g/sq. m) of zinc.
 - a. Polymer coating over metallic coating.

2.6 PRIVACY SLATS

- A. Fiber-Glass-Reinforced Plastic Slats: UV-light-stabilized fiber-glass-reinforced plastic, not less than 0.06 inch (1.5 mm) thick, sized to fit mesh specified for direction indicated, with vandal-resistant fasteners and lock strips.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the Work.
 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.
- B. Post Setting: Set posts in concrete with mechanical anchors at indicated spacing into firm, undisturbed soil.
 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Posts Set into Holes in Concrete: Form or core drill holes not less than 5 inches (127 mm) deep and 3/4 inch (20 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout or anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
- C. Line Posts: Space line posts uniformly at 96 inches (2440 mm) o.c.

- D. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at mid-height of fabric 72 inches (1830 mm) or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- E. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
 - 1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches (152 mm) of bottom of fabric and tie to each post with not less than same diameter and type of wire.
- F. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- G. Intermediate and Bottom Rails: Secure to posts with fittings.
- H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch (25-mm) bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches (380 mm) o.c.
- J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.
- K. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.]
- L. Privacy Slats: Install slats in direction indicated, securely locked in place.
 - 1. Vertically, for privacy factor of 70 to 75.

3.3 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.4 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes trash receptacles.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 TRASH RECEPTACLES

- A. Provide product indicated on Drawings.
 - 1. Receptacle Shape and Form: Square column with opening for depositing trash in side of lid.
 - 2. Lids and Tops: HDPE raised lid secured by steel chain.
 - a. Description: Hooded lid with two openings on opposite sides for depositing trash.
 - b. Color: Black
 - 3. Inner Container: Heavy-duty rotary molded polyethylene container square to fit receptacle designed to be removable and reusable.
 - 4. Disposable Liners: Provide receptacle designed to accommodate disposable liners.
 - 5. Capacity: Not less than 30 gallon (410 lbs.).
 - 6. Service Access: Removable lid; inner container and disposable liner lift or slide out for emptying.

2.2 MATERIALS

- A. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.
 - 1. Polyethylene: Fabricated from virgin plastic HDPE resin.

- B. Anchors, Fasteners, Fittings, and Hardware: As indicated on drawings.
 - 1. Anchors: For inconspicuously bolting legs of site furnishings to on-grade substrate; one per leg.
- C. Concrete: Solid, reinforced concrete in one-piece construction from steel molds.
 - 1. Exterior finish: exposed aggregate sealed with acrylic sealants.
 - 2. Color: Grey Granite
- D. Galvanizing: Where indicated for steel components, provide the following protective zinc coating applied to components after fabrication:
 - 1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil (0.0076 mm) thick.
 - 2. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

2.3 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- C. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.
- D. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

END OF SECTION 129300

SECTION 328400 - PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Piping.
2. Manual valves.
3. Automatic control valves.
4. Automatic drain valves.
5. Sprinklers.
6. Quick couplers.
7. Controllers.
8. Boxes for automatic control valves.

1.2 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
1. Irrigation Main Piping: 60 PSI
 2. Circuit Piping: 60 PSI

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Zoning Chart: Show each irrigation zone and its control valve.
- B. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedule 40
 - 1. PVC Socket Fittings: ASTM D 2466, Schedule 40
 - 2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
 - 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- C. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21
 - 1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
 - 2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

2.2 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 MANUAL VALVES

A. Curb Valves:

1. Description:

- a. Standard: AWWA C800.
- b. NPS 1 and Smaller Pressure Rating: [100 psig minimum]
- c. NPS 1-1/4 to NPS 2 Pressure Rating: [80 psig minimum]
- d. Body Material: Brass or bronze with ball or ground-key plug.
- e. End Connections: Matching piping.
- f. Stem: With wide-tee head.

B. Curb-Valve Casing:

1. Standard: Similar to AWWA M44 for cast-iron valve casings.
2. Top Section: Telescoping, of length required for depth of burial of curb valve.
3. Barrel: Approximately 3-inch (75-mm) diameter.
4. Plug: With lettering "WATER."
5. Bottom Section: With base of size to fit over valve.
6. Base Support: Concrete collar

C. Shutoff Rods for Curb-Valve Casings: Furnish one steel, tee-handle shutoff rod(s) with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve for Project.

D. Brass Ball Valves:

1. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded or solder joint if indicated.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full or regular

E. Bronze Ball Valves:

1. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded or solder joint if indicated.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.

j. Port: Full.

F. Iron Ball Valves:

1. Description:

- a. Standard: MSS SP-72.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Split body.
- d. Body Material: ASTM A 126, gray iron.
- e. Ends: Flanged.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.

G. Plastic Ball Valves:

1. Description:

- a. Standard: MSS SP-122.
- b. Pressure Rating: [125 psig (860 kPa) minimum] [150 psig (1035 kPa)].
- c. Body Material: PVC.
- d. Type: Union.
- e. End Connections: Socket or threaded.
- f. Port: Full.

H. Iron Gate Valves, Resilient Seated:

1. Description:

- a. Standard: AWWA C509.
- b. Pressure Rating: [200 psig (1380 kPa)] [250 psig (1725 kPa)] minimum.
- c. Body Material: Ductile or gray iron with bronze trim.
- d. End Connections: Mechanical joint or push-on joint.
- e. Interior Coating: Comply with AWWA C550.
- f. Body Design: Nonrising stem.
- g. Operator: Stem nut.
- h. Disc: Solid wedge with resilient coating.

I. Iron Gate Valve Casings:

- 1. Standard: AWWA M44 for cast-iron valve casings.
- 2. Top Section: Adjustable extension of length required for depth of burial of valve.
- 3. Barrel: Approximately 5-inch (125-mm) diameter.
- 4. Plug: With lettering "WATER."
- 5. Bottom Section: With base of size to fit over valve.
- 6. Base Support: Concrete collar[or wood frame].

J. Operating Wrenches for Iron Gate Valve Casings: Furnish [one] [two] <Insert number> steel, tee-handle operating wrench(es) with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut for Project.

2.4 AUTOMATIC CONTROL VALVES

A. Bronze, Automatic Control Valves:

1. Description: Cast-bronze body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

B. Plastic, Automatic Control Valves:

1. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

2.5 AUTOMATIC DRAIN VALVES

- ### A.
- Description: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig (17 to 20 kPa).

2.6 SPRINKLERS

- ### A.
- General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

B. Plastic, Exposed, Impact-Drive Rotary Sprinklers:

1. Description:
 - a. Construction: ABS and corrosion-resistant metals.
 - b. Mounting: Aboveground, exposed on riser.
2. Capacities and Characteristics:
 - a. Flow: 50 gpm

C. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:

1. Description:
 - a. Body Material: ABS.
 - b. Nozzle: Brass.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
2. Capacities and Characteristics:
 - a. Pop-up Height: 6"
 - b. Flow: 50 gpm

D. Plastic, Pop-up, Impact-Drive Rotary Sprinklers:

1. Description:
 - a. Case: ABS.

- b. Pop-up Height: Approximately 3 inches
 - c. Sprinkler Construction: ABS and other corrosion-resistant metals.
 - 2. Capacities and Characteristics:
 - a. Nozzle: Brass
 - b. Flow: 50 gpm
 - c. Pop-up Height: 6"
- E. Plastic, Surface Spray Sprinklers:
- 1. Description:
 - a. Body Material and Flange: ABS.
 - b. Pattern: Fixed, with flow adjustment.
 - 2. Capacities and Characteristics:
 - a. Nozzle: Brass
 - b. Flow: 50 gpm
- F. Plastic, Surface, Pop-up Spray Sprinklers:
- 1. Description:
 - a. Body Material and Flange: ABS.
 - b. Pattern: Fixed, with flow adjustment.
 - 2. Capacities and Characteristics:
 - a. Nozzle: Brass
 - b. Flow: 50 gpm
- G. Plastic, Pop-up Spray Sprinklers:
- 1. Description:
 - a. Body Material: ABS.
 - b. Nozzle: Brass
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
 - e. Pattern: Fixed, with flow adjustment.
 - 2. Capacities and Characteristics:
 - a. Nozzle: Brass
 - b. Flow: 50 gpm
- H. Plastic Shrub Sprinklers:
- 1. Description:
 - a. Body Material: ABS or other plastic.
 - b. Pattern: Fixed, with flow adjustment.

2. Capacities and Characteristics:
 - a. Flow: 50 gpm

2.7 QUICK COUPLERS

- A. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.

1. Locking-Top Option: Vandal-resistant locking feature. Include two key(s).

2.8 CONTROLLERS

- A. Description:

1. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.
2. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.
 - a. Body Material: Enameled-steel sheet metal
 - b. Mounting: Surface type for wall
3. Interior Control Enclosures: NEMA 250, Type 12, dripproof, with locking cover and two matching keys.
 - a. Body Material: Enameled-steel sheet metal
 - b. Mounting: Surface type for wall
4. Control Transformer: 24-V secondary, with primary fuse.
5. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
 - a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
 - b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
 - c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
6. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
7. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
 - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
 - b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
 - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

2.9 BOXES FOR AUTOMATIC CONTROL VALVES

A. Plastic Boxes:

1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
 - a. Size: As required for valves and service.
 - b. Shape: Rectangular
 - c. Sidewall Material: PE, ABS, or FRP
 - d. Cover Material: PE, ABS, or FRP

B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 3 inches maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."
- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches, to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
 1. Irrigation Main Piping: Minimum depth of 24 inches below finished grade, or not less than 18 inches below average local frost depth, whichever is deeper.
 2. Circuit Piping: 12 inches
 3. Drain Piping: 12 inches
 4. Sleeves: 24 inches

3.2 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.

- G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.
- H. Install expansion loops in control-valve boxes for plastic piping.
- I. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- J. Install ductile-iron piping according to AWWA C600.
- K. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- E. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
- F. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- G. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- H. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- I. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.4 VALVE INSTALLATION

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
 - 1. Install valves and PVC pipe with restrained, gasketed joints.
- C. Aboveground Valves: Install as components of connected piping system.
- D. Throttling Valves: Install in underground piping in boxes for automatic control valves.
- E. Drain Valves: Install in underground piping in boxes for automatic control valves.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches (100 mm) from walls and 2 inches (50 mm) from other boundaries unless otherwise indicated.

3.6 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install interior controllers on wall.
 - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install control cable in same trench as irrigation piping and at least 2 inches (51 mm) below piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
 - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 312000 "Earth Moving" for warning tapes.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Any irrigation product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than [1/2 inch (13 mm)] <Insert value> above, finish grade.

3.10 PIPING SCHEDULE

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.
- C. Underground irrigation main piping, [NPS 4 and smaller shall be the following:
 - 1. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.
- D. Circuit piping, NPS 2 and smaller, shall be the following:
 - 1. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.
- E. Circuit piping, [NPS 2-1/2 to NPS 4 shall be the following:
 - 1. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.
- F. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.

1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.
- G. Risers to Aboveground Sprinklers and Specialties: Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.
- H. Drain piping shall be the following:
 1. SDR 21, 26, or 32.5, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

3.11 VALVE SCHEDULE

- A. Underground, Shutoff-Duty Valves: Use the following:
 1. NPS 2 and Smaller: Curb valve, curb-valve casing, and shutoff rod.
 2. NPS 3 and Larger: Iron gate valve, resilient seated; iron gate valve casing; and operating wrench(es).
- B. Aboveground, Shutoff-Duty Valves:
 1. NPS 2 and Smaller: Brass ball valve.
 2. NPS 2-1/2 and Larger: Iron ball valve.
- C. Throttling-Duty Valves:
 1. NPS 2 (DN 50) and Smaller: Brass ball valve.
 2. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): Iron ball valve.
- D. Drain Valves:
 1. NPS 1/2 and NPS 3/4: Brass ball valve.

END OF SECTION 328400

SECTION – SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes planting soils and layered soil assemblies specified by composition of the mixes.
- B. Related Requirements:
 - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
 - 2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
 - 3. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

- K. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- M. SSSA: Soil Science Society of America.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- Q. USCC: U.S. Composting Council.

1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.
 - 1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.
- B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
 - 1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.5 SOIL-SAMPLING REQUIREMENTS

- A. General: Extract soil samples according to requirements in this article and testing agency instructions.

1.6 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:
 - 1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

- a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
 - b. Hydrometer Method: Report percentages of sand, silt, and clay.
 2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).
- C. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT SERA-6, including the following:
1. CEC, calcium percent of CEC, and magnesium percent of CEC.
 2. Soil reaction (acidity/alkalinity pH value).
 3. Nitrogen ppm.
 4. Phosphorous ppm.
 5. Potassium ppm.
- D. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Do not move or handle materials when they are wet or frozen.
 4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: O, with a minimum of 95 percent passing through a No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through a No. 60 (0.25-mm) sieve.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through a No. 40 (0.425-mm) sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 (0.30-mm) sieve.
- F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
 - 1. Feedstock: Limited to leaves and may include animal waste.
 - 2. Reaction: pH of 5.5 to 8.
 - 3. Soluble-Salt Concentration: Less than 4 dS/m.
 - 4. Moisture Content: 35 to 55 percent by weight.
 - 5. Organic-Matter Content: 30 to 40 percent of dry weight.
 - 6. Particle Size: Minimum of 98 percent passing through a 2-inch (50-mm) sieve.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch (13-mm) sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 1/2-inch (13-mm) sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
 - 1. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. (2.4 kg/cu. m) of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. (0.5 kg/100 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARING AND PLACING AMENDED PLANTING SOIL

- A. General: Amending existing topsoil to create planting soil, excavate soil, stock pile and mix amendments to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Apply soil amendments and fertilizer, if required; thoroughly blend them with unamended soil to produce planting soil.

1. Mix lime with dry soil before mixing fertilizer.
 2. Mix fertilizer with planting soil no more than seven days before planting.
- C. Preparation: Till existing soil in planting areas to a minimum depth of 6 inches (150 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- D. Placing Planting Soil: Apply planting soil in lifts not exceeding 4 inches in loose depth around plants as indicated on drawings. Compact soil by hand tamping in-place or by hand operated tampers. See also section 329300 PLANTS.
- E. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.
- F. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 PLACING OFFSITE PLANTING SOIL

- A. Preparation: Till existing soil in planting areas to a minimum depth of 6 inches (150 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- B. Placing Planting Soil: Apply planting soil in lifts not exceeding 4 inches in loose depth around plants as indicated on drawings. Compact soil by hand tamping in-place or by hand operated tampers. See also section 329300 PLANTS.
- C. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.
- D. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PROTECTION

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Vehicle traffic.
 4. Foot traffic.
 5. Erection of sheds or structures.
 6. Impoundment of water.
 7. Excavation or other digging unless otherwise indicated.

- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.5 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
 - 1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Seeding.
2. Hydroseeding.
3. Sodding.
4. Turf renovation.
5. Erosion-control material(s).

- B. Related Requirements:

1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 4. Personnel Certifications: Installer's personnel assigned to the Work shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Lawncare Manager.
 - c. Landscape Industry Certified Lawncare Technician.
 - 5. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation"

sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: April 1 thru August 30.
2. Fall Planting: August 30 thru March 31.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: State-certified seed of grass species as listed below for solar exposure.
2. Quality: Seed of grass species as listed below for solar exposure, with not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
3. Species: Per Landscape Plan(s).

2.2 TURFGRASS SOD

A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

B. Turfgrass Species: Per Landscape Plan(s).

2.3 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.4 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.
- C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- E. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- F. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- G. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.5 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- C. Erosion-Control Mats: Cellular, nonbiodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 4-inch (100-mm) nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Invisible Structures, Inc; Slopetame 2.
 - b. Presto Products Company; Geoweb.
 - c. Tenax Corporation - USA; Tenweb.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."
- B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.
 - 1. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Turf Area Preparation" Article.
- B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- C. Fill cells of erosion-control mat with planting soil and compact before planting.
- D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h).
 - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft. (1.4 to 1.8 kg/92.9 sq. m).
- C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
 - 2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. (38 to 49 L/92.9 sq. m). Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- G. Protect seeded areas from hot, dry weather or drying winds by applying peat mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch (4.8 mm) and roll surface smooth.

3.6 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, slow-release fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
 - 2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre (15.6-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
 - 3. Spray-apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre (5.2-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre (10.4 kg/92.9 sq. m).

3.7 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.8 TURF RENOVATION

- A. Renovate existing turf where indicated.
- B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - 2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).
- I. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches (100 mm) of existing soil. Install new planting soil to fill low spots and meet finish grades.
 - 1. Soil Amendment(s): Insert required soil amendment(s) according to requirements of Section 329113 "Soil Preparation". Apply soil amendments as recommended by soil testing agency.

2. Initial Fertilizer: Slow-release fertilizer applied according to manufacturer's recommendations.

J. Apply sod and/or seed and protect with straw mulch as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.9 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).
1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Revise timing of fertilizer application in "Turf Postfertilization" Paragraph below if a slow-release fertilizer is initially applied.
- D. Turf Postfertilization: Apply slow-release fertilizer after initial mowing and when grass is dry, if a slow-release fertilizer is not initially applied.
1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to turf area.

3.10 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).

2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
 3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
 4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.11 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.12 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

3.13 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
1. Seeded Turf: 60 days from date of Substantial Completion
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
 2. Sodded Turf: 60 days from date of Substantial Completion.

The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

END OF SECTION 329200

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Plants.

- B. Related Requirements:

- 1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
 - 2. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- E. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- F. Finish Grade: Elevation of finished surface of planting soil.

- G. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- H. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- I. Planting Area: Areas to be planted.
- J. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.
- K. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- L. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- M. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- N. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - 2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.
 - 3. Planting Soil: Include all soil mixtures to be used.
- B. Samples for Verification: For each of the following:
 - 1. Nursery Sources: Submit a list of all nurseries that will supply plants, along with a list of the plants they will provide and the location of the nursery. Plants shall have been grown within the cold hardiness zone for the project site.

2. Trees and Shrubs: Three Samples of each variety and size delivered to site for review. Maintain approved Samples on-site as a standard for comparison.
3. Mulch: 1 lb volume of each mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
4. Slow-Release, Tree-Watering Device: One unit of each size required.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 1. Manufacturer's certified analysis of standard products.
 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- B. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- C. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's personnel assigned to the Work shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Interior.
 - c. Landscape Industry Certified Horticultural Technician.
 5. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

- C. Soil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
 - 1. Based on the test results, state recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil.
 - 2. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium.
 - D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
 - E. Substitutions:
 - 1. Substitutions for the listed plant material will be considered if the listed material cannot be located or confirmed by known suppliers. Plant suppliers must be researched and located prior to submittal. If plant material substitutions are to be made after award of the contract, the substitution must be of similar growth habit, form, and characteristics; similar in specified size; and subject to approval or rejection by the Owner's representative.
 - 2. If for any reason trees cannot be installed according to the plans, the Contractor shall inform the Owner prior to plant material delivery, and alternate planting locations shall be selected by the Owner's representative.
 - F. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
 - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
 - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
 - G. Plant Material Observation: Architect may observe plant material at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify Architect of sources of planting materials seven days in advance of delivery to site.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
 - B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.
- D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- E. Handle planting stock by root ball.
- F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.
- G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 3. Do not remove container-grown stock from containers before time of planting.
 4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.
- 1.11 FIELD CONDITIONS
- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: April 1 thru August 30.
2. Fall Planting: August 30 thru March 31.

- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Periods: From date of Substantial Completion.
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers and Other Plants: 12 months.
3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing

trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots are unacceptable.

2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
 - C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
 - D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
 - E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 1. Size: 5-gram tablets.
 2. Nutrient Composition: 10 percent nitrogen, 5 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- C. Slow-Release Fertilizer: Granular or pelletized fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
 2. Fish-emulsion compost tea.

2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 1. Type: Pine needles.

2.4 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101g/sq. m) minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

2.5 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 LANDSCAPE EDGINGS

- A. Edging: Shovel dug only as indicated on Drawings

2.7 MISCELLANEOUS PRODUCTS

- A. Root Barrier: Black, molded, modular panels manufactured with minimum 50 percent recycled polyethylene plastic with UV inhibitors or herbicide impregnated fabric manufactured for this use.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
 - 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation." Loosen soil to a depth of 6" minimum. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- B. Placing Planting Soil: Place planting soil over exposed subgrade to a depth as indicated on drawings but not less than required to meet finish grades after natural settlement. Soil mixes to be thoroughly blended offsite. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
 - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 2. Excavate approximately three times as wide as ball diameter.
 - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.

5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 6. Maintain supervision of excavations during working hours.
 7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE AND SHRUB PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
1. Backfill: Planting soil.
 2. Balled and Burlapped Stock: After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Balled and Potted and Container-Grown Stock: Carefully remove root ball from container without damaging root ball or plant.
 4. Fabric Bag-Grown Stock: Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 5. Bare-Root Stock: Support stem of each plant and spread roots without tangling or turning toward surface. Plumb before backfilling, and maintain plumb while working. Carefully work backfill around roots by hand. Bring roots into close contact with the soil.
 6. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 7. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 8. Continue backfilling process. Water again after placing and tamping final layer of soil.

- D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE AND SHRUB PRUNING

- A. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- B. Do not apply pruning paint to wounds.

3.7 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.8 PLANTING AREA MULCHING

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Treelike Shrubs in Turf Areas: Apply mulch ring as indicated on drawings. Do not place mulch within 6 inches of trunks or stems.
 - 2. Mulch in Planting Areas: Apply at a depth as indicated on drawings an average thickness of organic or mineral mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 4 inches of trunks or stems.

3.9 EDGING INSTALLATION

- A. Shovel-Cut Edging: Separate mulched areas from turf areas with a 45-degree, 4- inch deep, shovel-cut edge as indicated on Drawings.

3.10 INSTALLING SLOW-RELEASE WATERING DEVICE

- A. Provide one device for each tree.
- B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.11 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- D. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- F. Watering Instruction:
 - 1. Watering volumes should be based upon delivery of 1 inch of moisture per week to the plant if precipitation does not meet that amount during the active growing season defined as April 1 through November 1.
 - 2. Supplemental water shall be applied during the establishment period as frequently as 3 times per week and during periods of drought or excessive heat.

3.12 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.13 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Remove and replace material that is more than 25 percent dead or in an unhealthy condition before the end of the corrections period or is damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
 - 1. Provide new material of same size and species as those being replaced.

3.14 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.15 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 - 1. Maintenance Period: 12 months from date of Substantial Completion.
- B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 - 1. Maintenance Period: Six months from date of Substantial Completion.

The University of North Carolina at Wilmington
Parking Deck II and Surface Parking (Design-Build)
April 15, 2019

SCO# 18-19226-01A, Code: 41828, Item 301
Clark Nexsen Commission No. 8112
Construction Documents Submittal 01

END OF SECTION 329300

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Nonpressure transition couplings.
 - 3. Pressure pipe couplings.
 - 4. Expansion joints and deflection fittings.
 - 5. Backwater valves.
 - 6. Cleanouts.
 - 7. Drains.
 - 8. Encasement for piping.
 - 9. Manholes.
 - 10. Channel drainage systems.
 - 11. Catch basins.
 - 12. Stormwater inlets.
 - 13. Stormwater detention structures.
 - 14. Pipe outlets.
 - 15. Dry wells.
 - 16. Stormwater disposal systems.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Manholes: Include plans, elevations, sections, details, frames, and covers.
 - 2. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
 - 3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- B. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- C. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Architect's written permission.

PART 2 - PRODUCTS

2.1 ABS PIPE AND FITTINGS

- A. ABS Sewer Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints.
 - 1. NPS 3 to NPS 6: SDR 35.
 - 2. NPS 8 to NPS 12: SDR 42.
- B. Gaskets: ASTM F 477, elastomeric seals.

2.2 PE PIPE AND FITTINGS

- A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
 - 1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

2. Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.

- B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
2. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

2.3 PVC PIPE AND FITTINGS

- A. PVC Cellular-Core Piping:

1. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 3034, SDR 35, PVC socket-type fittings.

- B. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F 949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals.

- C. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

- D. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

- E. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F 679, T-1 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

2.4 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.

1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with bitumen or butyl-rubber sealant
2. Class III, Wall B.
3. Class IV, Wall B.

2.5 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.
 - 2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following or Engineer approved equivalent:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco Inc.
 - c. Logan Clay Pipe.
 - d. Mission Rubber Company; a division of MCP Industries, Inc.
 - e. NDS Inc.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - 3. Description: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Shielded, Flexible Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following or Engineer approved equivalent:
 - a. Cascade Waterworks Mfg.
 - b. Dallas Specialty & Mfg. Co.
 - c. Mission Rubber Company; a division of MCP Industries, Inc.
 - 3. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- E. Ring-Type, Flexible Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following or Engineer approved equivalent:
 - a. Fernco Inc.
 - b. Logan Clay Pipe.
 - c. Mission Rubber Company; a division of MCP Industries, Inc.
3. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.6 CLEANOUTS

A. Plastic Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following or Engineer approved equivalent:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
3. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.7 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps

into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches .

10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Designed Precast Concrete Manholes:

1. Description: ASTM C 913; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
5. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
6. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
7. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: [ASTM A 536, Grade 60-40-18 ductile] [ASTM A 48/A 48M, Class 35 gray] iron unless otherwise indicated.

2.8 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 2. Benches: Concrete, sloped to drain into channel.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.9 CATCH BASINS

- A. Standard Precast Concrete Catch Basins:
1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
 3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
 7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.
 8. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
 9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
- B. Designed Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for joint sealants.
1. Joint Sealants: ASTM C 990, bitumen or butyl rubber.
 2. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.

3. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.
 4. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
 5. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
- C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.
1. Size: 24 by 24 inches minimum unless otherwise indicated.
 2. Grate Free Area: Approximately 50 percent unless otherwise indicated.
- D. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter flat grate with small square or short-slotted drainage openings.
1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.10 STORMWATER INLETS

- A. Combination Inlets: Made with vertical curb and horizontal gutter openings. Include heavy-duty frames and grates.
- B. Frames and Grates: Heavy duty.

2.11 STORMWATER DETENTION STRUCTURES

- A. Cast-in-Place Concrete, Stormwater Detention Structures: Constructed of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
1. Ballast: Increase thickness of concrete as required to prevent flotation.
 2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and cover.
 3. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 60 inches.
- B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.12 PIPE OUTLETS

- A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

- B. Riprap: Broken, irregularly sized and shaped, graded stone according to NCDOT's "Standard Specification for Roads and Structures."
 - 1. Average Size: Class B, 8 inches.
 - 2. Average Size: Class 1, 10 inches.
 - 3. Average Size: Class 2, 14 inches.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow.
 - 2. Install piping with 24-inch minimum cover.
 - 3. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 4. Install PE corrugated sewer piping according to ASTM D 2321.
 - 5. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
 - 6. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.
 - 7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.

2. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
3. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
4. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
5. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.5 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.6 STORMWATER INLET AND OUTLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
- B. Construct riprap of broken stone, as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- E. Construct energy dissipaters at outlets, as indicated.

3.7 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.8 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.

2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
 1. Remove manhole or structure and close open ends of remaining piping.
 2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Section 312000 "Earth Moving."

3.9 IDENTIFICATION

- A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 1. Metallic lines shall be identified with durable printed plastic warning tapes, minimum 3 inches wide with lettering to identify buried line below.
 2. Non-metallic pipes, shall have two stages of identification containing warning tape and detectable magnetic markers.

3.10 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.

3.11 CLEANING

- A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 334100

