

PROJECT MANUAL

**SITE DEVELOPMENT
AT
ROSA PARKS SQUARE**

701 Poplar Street
Macon, GA 31201
HGOR #21026

OWNER:
Macon-Bibb County

11/10/2021

HGOR

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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. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
 - 4. Requests for Interpretation (RFIs).
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

1.3 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

- 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.
- 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 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 accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- 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 and activities of other contractors 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. Delivery and processing of submittals.
 4. Progress meetings.
 5. Preinstallation conferences.
 6. Startup and adjustment of systems.
 7. Project closeout activities.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate required installation sequences.
 - c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Landscape Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
 3. Number of Copies: Submit two opaque copies of each submittal. Landscape Architect will return one copy.
 - a. Submit five copies where Coordination Drawings are required for operation and maintenance manuals. Landscape Architect will retain one copy; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing.
 4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.
- B. Key Personnel Names: Within 15 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 telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
1. Include special personnel required for coordination of operations with other contractors.

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Landscape Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Landscape Architect, within five (5) days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Landscape Architect, but no later than fifteen (15) days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives of Owner, Landscape Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers;

suppliers; and other concerned parties shall attend the conference. All 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. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of Record Documents.
 - l. Use of the premises.
 - m. Work restrictions.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Construction waste management and recycling.
 - q. Parking availability.
 - r. Office, work, and storage areas.
 - s. Equipment deliveries and priorities.
 - t. First aid.
 - u. Security.
 - v. Progress cleaning.
 - w. Working hours.
3. Minutes: Record and distribute meeting minutes.

1.8 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
 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 interpretation and the following:
 1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Name of Landscape Architect.

5. RFI number, numbered sequentially.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Hard-Copy RFIs:
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Landscape Architect's Action: Landscape Architect review each RFI, determine action required, and return it. Allow seven working days for Landscape Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Landscape Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 2. Landscape Architect's action may include a request for additional information, in which case Landscape Architect's time for response will start again.
 3. Landscape 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 Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Landscape Architect in writing within seven (7) calendar days of receipt of the RFI response.
- F. On receipt of Landscape Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Landscape Architect within five (5) calendar days if Contractor disagrees with response.

- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log bi-weekly. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Landscape Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Landscape 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS:

- A. Inspection of Conditions: Require the installer of each major component to inspect both the substrate and condition under which work is to be performed. Do not proceed until satisfactory conditions have been corrected in an acceptable manner.
- B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
- C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
- D. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Landscape Architect for final decision.
- E. Recheck dimensions and measurements, before starting each installation.
- F. Temporary Utilities: Monitor the use and verify that adequate services are provided and maintained.

3.2 CLEANING AND PROTECTION

- A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

- B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period.

END OF SECTION 013100

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. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Landscape Architect's responsive action.
- B. Informational Submittals: Written information that does not require Landscape Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Landscape Architect for Contractor's use in preparing submittals.
- 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. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Landscape Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: Comply with requirements in Division 01 Section "Submittal Procedures" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Landscape 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 ten (10) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Landscape 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 ten (10) days for review of each resubmittal.
- E. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Landscape Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- G. Additional Copies: Unless additional copies are required for final submittal, and unless Landscape Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Landscape Architect will discard submittals received from sources other than Contractor.
1. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).

- e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Specification Section number and title.
 - i. Drawing number and detail references, as appropriate.
 - j. Transmittal number, numbered consecutively.
 - k. Submittal and transmittal distribution record.
 - l. Remarks.
 - m. Signature of transmitter.
2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Landscape Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked "Approved".
 - J. 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.
 - K. Use for Construction: Use only final submittals with mark indicating "Approved" taken by Landscape Architect.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
 1. Number of Copies: Submit three (3) copies of each submittal, unless otherwise indicated. Landscape Architect, will return two (2) copies. Mark up and retain one returned copy as a Project Record Document.
 2. Number of Copies: Submit copies of each submittal, as follows, unless otherwise indicated:
 - a. Initial Submittal: Submit a preliminary single copy of each submittal where selection of options, color, pattern, texture, or similar characteristics is required. Landscape Architect will return submittal with options selected.
 - b. Final Submittal: Submit three (3) copies, unless copies are required for operation and maintenance manuals. Submit five (5) copies where copies are required for operation and maintenance manuals. Landscape Architect will retain two (2) copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Document.

- B. 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 printed data are not suitable 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 written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Mill reports.
 - i. Standard product operation and maintenance manuals.
 - j. Compliance with specified referenced standards.
 - k. Testing by recognized testing agency.
 - l. Notation of coordination requirements.
- C. 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.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Templates and patterns.
 - g. Schedules.
 - h. Design calculations.
 - i. Compliance with specified standards.
 - j. Notation of coordination requirements.
 - k. Notation of dimensions established by field measurement.
 - l. Relationship to adjoining construction clearly indicated.
 - m. Seal and signature of professional engineer if specified.
 - n. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 18 by 24 inches but no larger than 30 by 42 inches.
 3. Number of Copies: Submit copies of each submittal as follows:
 - a. Initial Submittal: Submit one correctable, translucent, reproducible print and three (3) blue- or black-line prints. Landscape Architect will return the reproducible print.

- b. Final Submittal: Submit three (3) blue- or black-line prints, unless prints are required for operation and maintenance manuals. Submit five (5) prints where prints are required for operation and maintenance manuals. Landscape Architect will retain two (2) prints; remainder will be returned.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed. Prepare physical units of materials or products, including the following:
 1. Comply with requirements in Division 01 Section "Quality Requirements" for mockups.
 2. Identification/Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Landscape Architect's sample where so indicated. Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
 3. 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.
 4. 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 for Initial Selection: Submit one (1) full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Landscape Architect will return submittal with options selected.
 5. 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 for Verification: Submit three (3) sets of Samples. Landscape Architect will retain two (2) Sample sets; remainder will be returned.

- 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 three (3) sets of paired units that show approximate limits of variations.
- E. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- F. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Number of Copies: Submit two (2) copies of each submittal, unless otherwise indicated. Landscape Architect will return one (1) copy.
 2. Certificates and Certifications: Provide a notarized statement that includes signature of [entity] [Contractor, testing agency, or design professional] 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.
 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- D. Installer Certificates: Prepare 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.
- E. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- F. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- G. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

- H. Material Test Reports: Prepare 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.
- I. Product Test Reports: Prepare written reports indicating 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.
- J. Preconstruction Test Reports: Prepare 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.
- K. Compatibility Test Reports: Prepare 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.
- L. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, 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.
- M. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data." "Closeout Procedures."
- N. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- O. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.
 - 3. Sequence of installation or erection.
 - 4. Required installation tolerances.
 - 5. Required adjustments.
 - 6. Recommendations for cleaning and protection.
- P. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service 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.
- Q. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- R. Construction Photographs: Comply with requirements specified in Division 01 Section "Photographic Documentation."
- S. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Landscape Architect.
1. Landscape Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

2.3 DELEGATED DESIGN

- 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 Landscape Architect.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit five (5) copies of 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.
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.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. 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 Landscape Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.2 LANDSCAPE ARCHITECT'S ACTION

- A. General: Landscape Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Landscape Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Landscape Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. Final Unrestricted Release: Where submittals are marked "No Exceptions Taken," that part of the work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 - 2. Final-but-Restricted Release: Where submittals are marked "Approved as Noted," that part of the work covered by the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
 - 3. Returned for Re-submittal: When submittal is marked "Rejected, Resubmit," do not proceed with that part of the work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations, re-submit without delay. Repeat if necessary to obtain a different action mark.
 - 4. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the Landscape Architect will return the submittals marked "No Action Taken," or "For Information Only."
- C. Informational Submittals: Landscape Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Landscape Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

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. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting 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 -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Landscape Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. 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.
- B. 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. Services do not include contract enforcement activities performed by Landscape Architect.
- C. Mockups: Full-size, physical assemblies to illustrate finishes and materials; that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

- D. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. 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, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- I. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of fifteen (15) previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Landscape Architect for a decision 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 Landscape Architect for a decision before proceeding.

1.5 SUBMITTALS

- A. Qualification Data: 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.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Description of the Work and test and inspection method.
6. Identification of product and Specification Section.
7. Complete test or inspection data.
8. Test and inspection results and an interpretation of test results.
9. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
10. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
11. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner's records, 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.

1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, 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.
- C. 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.
- D. 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.
- 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 to those indicated for this Project in material, design, and extent.

- F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

- G. 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.

- H. 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 and 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.
 - e. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Landscape Architect, 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.

- I. 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 in location and of size indicated or, if not indicated, as directed by Landscape Architect.
 - 2. Notify Landscape Architect seven (7) calendar days in advance of dates and times when mockups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Landscape Architect's approval of mockups before starting work, fabrication, or construction.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor's Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. 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.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least forty-eight (48) hours in advance of time when Work that requires testing or inspecting will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. 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 Division 01 Section "Submittal Procedures."
- D. 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.
- E. Testing Agency Responsibilities: Cooperate with Landscape Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Landscape Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location 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 any duties of Contractor.
- F. Associated Services: Cooperate with agencies 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 inspecting. 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 inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
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. Submit schedule within fifteen (15) days of date established for commencement of the Work.
- 1.8 SPECIAL TESTS AND INSPECTIONS
- A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.
- B. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.

2. Notifying Landscape Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Landscape Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. 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 Landscape Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Landscape Architect's and Owner's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, 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. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- 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 015639 - TEMPORARY TREE AND PLANT PROTECTION

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 protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction. Trees which are to remain and shall be protected are indicated on the Drawings.

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters of multi-trunk trees at six (6) inches (150 mm) above the ground for trees up to, and including, four (4) inch (100-mm) size; and twelve (12) inches (300 mm) above the ground for trees larger than four (4) inch (100-mm) size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 SUBMITTALS

- A. Section Cross Reference: Refer to Division 1 Submittals Section for general requirements.
- B. Product Data: For each type of product indicated.
- C. Samples for Verification: For each type of the following:
 - 1. Organic Mulch: 1-quart (1-L) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
 - 2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
 - 3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

E. Qualification Data: For qualified arborist and tree service firm.

F. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

G. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

H. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

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.

I. The Contractor will obtain from each subcontractor representative, a signed statement stating that the subcontractors have reviewed the Tree Protection Program, understand it, and will comply with it. Copies of signed statements shall be submitted to the Owner.

1.5 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
 - b. Enforcing requirements for protection zones.
 - c. Arborist's responsibilities.
 - d. Field quality control.

1.6 PROJECT CONDITIONS

- A. Copy of the Tree Protection Plans are to be posted at the project site by the contractor, in the contractor's trailer. The contractor shall review the Tree Protection Program with all active subcontractors on a monthly basis at regularly scheduled job progress meetings.
- B. Trees indicated to remain are essential to the Project.
- C. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Trash and construction debris.
 - 3. Parking vehicles or equipment.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
 - 8. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- D. Do not direct vehicle or equipment exhaust toward protection zones.
- E. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.
- F. Temporary Protection: Provide temporary fencing, barricades, or other suitable guards located outside drip-line (outer perimeter of branches) or as recommended by the Arborist to protect trees and other plants that are to remain from damage.
- G. Leave all protection in place and maintain until construction work has been completed and all danger of damage has passed. Protection shall be removed only after approval is given by the Landscape Architect.
- H. Water trees and other vegetation, to remain within limits of contract work, as required to maintain their health during course of construction operations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; 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 one (1) inch (25 mm) in diameter; and free of weeds, roots, and toxic and other nonsoil materials.
 - 1. Obtain topsoil only from well-drained sites where topsoil is four (4) inches (100 mm) deep or more; do not obtain from bogs or marshes.

- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
1. Type: Ground or shredded bark.
 2. Size Range: two (2) inches (50 mm) maximum, one-half (1/2) inch (13 mm) minimum.
 3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements. Previously used materials may be used when approved by Landscape Architect.
1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum two (2) inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts with 0.177-inch- (4.5-mm-) diameter top tension wire and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
 - a. Height: six (6) feet (1.8 m).
 2. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with two (2) inch (50-mm) maximum opening in pattern and weighing a minimum of 0.4 lb/ft. (0.6 kg/m); remaining flexible from minus 60 to plus 200 deg F (minus 16 to plus 93 deg C); inert to most chemicals and acids; minimum tensile yield strength of 2000 psi (13.8 MPa) and ultimate tensile strength of 2680 psi (18.5 MPa); secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than eight (8) feet (2.4 m) apart.
 - a. Height: [four (4) feet (1.2 m)].
 - b. Color: High-visibility orange, nonfading.
 3. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width thirty-six (36) inches (914 mm).
- D. Protection-Zone and Designated Concrete Wash-out Area Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
1. Size and Text: As shown on Drawings
 2. Lettering: three (3) inch- (75-mm-) high minimum, black characters on white background.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Report any unsatisfactory conditions or faulty

installation prior to beginning work. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag each tree trunk at fifty-four (54) inches (1372 mm) above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
 - 1. Apply four (4) inch (100-mm) average thickness of organic mulch. Do not place mulch within twelve (12) inches (300 mm) of tree trunks.
- D. Access and Sequence:
 - 1. All access for construction purposes must remain within designated corridors.
 - 2. Construction equipment must be of proper size and maneuverability to be able to remain within the confines of the corridors without damaging trees.
 - 3. Construction procedures must be sequentially scheduled to assure that access can be obtained without violating the tree protection areas.
- E. Final location of all underground utilities that will encroach upon tree protection areas must be field staked and approved prior to beginning work.

3.3 TREE- AND PLANT-PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 - 1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
 - 2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
 - 3. Access Gates: Install where indicated; adjust 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. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Landscape Architect. Install one sign spaced approximately every fifty (50) feet (15 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction. Install additional signs at each access gate.
- C. Concrete Area Wash-Out Signage: Install concrete area wash-out signage at each designated area, mounted eight (8) feet above grade
- D. Maintain protection zones free of weeds and trash.
- E. 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 Landscape Architect.
- F. Maintain protection-zone fencing and signage in good condition as acceptable to Landscape Architect and remove when construction operations are complete and equipment has been removed from the site.
 - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 CLEARING

- A. Before clearing, the Contractor shall verify all clearing limits.
- B. Tree Felling: Trees to be removed must be felled towards open areas and not felled into the tree protection areas and drug out. Some stumps may be left, cut flush with grade as designated by the Owner or Landscape Architect. These trees may occur along the edge of clearing limits and in areas where large tree stumps, if excavated, would disturb areas where trees are indicated to remain.

3.5 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Division 31 Section "Earth Moving."
- B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.
- C. Where excavating for new construction is required within tree protection zones of trees, hand excavate to minimize damage to root systems. Provide sheeting at excavations if required. Use narrow-tine spading forks and comb soil to expose roots. Engage an Arborist to survey root radius and locate large lateral support roots prior to work.

- D. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots as directed by the Arborist to avoid new construction.
- E. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.6 CONCRETE AND MORTAR

- A. Concrete Trucks: All concrete trucks must be washed out only at designated concrete wash-out areas that are determined prior to work beginning and as submitted in logistics plan.
- B. Mortar: Mortar is to be mixed only within designated area. All run-off from mortar mixing must be contained or directed away from root areas to avoid soil contamination. Mortar operations must be reviewed and approved by the Owner.

3.7 DRAIN LINES

- A. Location: The final location for drain lines must be field-staked and reviewed by the Owner before installation.
- B. Where lines are installed through tree protection zones, care must be taken to assure that as many trees as possible will survive and that damage to the trees in these areas will be minimized. The edges of each trench are to be pre-cut with a trenching machine to prune the roots. Dirt is to be piled on a base of landscape fabric and only in designated areas. Ditches are to be filled in quickly, as soon as the pipe can be laid, to minimize exposure of the subsoil. Tree and silt fencing is to be removed only temporarily where necessary, and replaced immediately following installation.

3.8 LIGHTING AND IRRIGATION

- A. Location: Electrical conduit and irrigation pipe should be run under walkways within stone or concrete subbase material. Lateral lines should be as close to the soil surface as possible with short runs from main conduit to individual lights and from irrigation main line to individual irrigation zones.
- B. Installation: Electrical fixtures and housing of irrigation valves must be installed with care to avoid cutting roots. Digging must be minimal with excess dirt hauled off. Do not cut roots greater than two (2) inches in diameter without the approval of the Owner.

3.9 TERRACES, RETAINING WALLS, AND CONCRETE PATHWAYS

- A. Installation: Cut into existing grade to minimum depth and width required. Cut should be made no deeper or wider than shown in detail with all edges cut vertically and not sloped back. Do

not compact the subgrade where large roots and/or areas of high root density exist. Contact the Owner prior to beginning work in these areas. Geotextile fabric may be required to be installed in these areas along the corridors. Poured concrete, crushed rock and asphalt must remain within forms and pathway edges.

- B. Roots: Roots greater than two (2) inches in diameter exposed during excavation should not be cut. Contact the Owner for instructions in this event.

3.10 ROOT PRUNING

- A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:
 - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 - 2. Cut Ends: Coat cut ends of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist.
 - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 4. Cover exposed roots with burlap and water regularly.
 - 5. Backfill as soon as possible according to requirements in Division 31 Section "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune roots 12 inches (300 mm) outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.11 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
 - 1. Remove branches from trees that are to remain, if required to clear new construction.
 - a. Where directed by Landscape Architect and verified by Arborist, extend pruning operation to restore natural shape of entire tree.
 - 2. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
 - 3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
 - 4. All pruning and cutting of branches and roots shall be performed by an Arborist using state of the art equipment.
 - 5. Cut branches with sharp pruning instruments; do not break or chop.
 - 6. Do not apply pruning paint to wounds.

- B. Chip removed branches and spread over areas identified by Owner or dispose of off-site.

3.12 REGRADING

- A. Maintain existing grade within tree protection zone.
- B. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- C. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
 - 1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- D. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- E. Minor Fill within Protection Zone: Where existing grade is six (6) inches (150 mm) below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations. Consult Arborist prior to work to verify that this action will not damage specific tree species affected.
- F. Moderate Fills: Where existing grade is more than six (6) inches, but less than twelve (12) inches below finish grade elevation, place a layer of drainage fill, filter fabric and a final layer of topsoil on existing grade.
 - 1. Carefully place against trunk of tree approximately two (2) inches above finish grade elevation and extend not less than eighteen (18) inches from tree trunk on all sides. For balance of area within drip line perimeter, place drainage fill to an elevation 6 inches below grade.
 - 2. Place filter fabric with overlapping edges of six (6) inches minimum.
 - 3. Place fill layer of topsoil to finish grade elevation. Do not compact drainage fill or topsoil layers; hand grade to required elevations.

3.13 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.14 REPAIR AND REPLACEMENT

- A. General: 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 Landscape Architect.
 - 1. Submit details of proposed root cutting and tree and shrub repairs.

2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
 3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
 4. Perform repairs within 24 hours.
 5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 30 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Arborist determines are incapable of restoring to normal growth pattern.
1. Provide new trees of same size and species as those being replaced. Plant and maintain as specified by Landscape Architect.
 2. If trees over six (6) inches in caliper measurements (taken twelve (12) inches above grade) are required to be replaced, provide new trees of six (6) inch caliper size and of species selected by the Landscape Architect.
 3. Plant and maintain new trees as specified in Division 32 Section "Plants."
- C. Specimen Trees: Where trees indicated to remain are determined to be essential to the Project prior to any construction activities, the Owner may impose monetary penalties related to damage and subsequent death of these trees in addition to the above requirements.
- D. Soil Aeration: Where directed by Arborist, aerate surface soil compacted during construction. Aerate twenty (20) feet (6 m) beyond drip line and no closer than seventy-two (72) inches (1800 mm) to tree trunk. Drill two (2) inch- (50-mm-) diameter holes a minimum of twelve (12) inches (900 mm) deep at thirty-six (36) inches (900 mm) o.c. Backfill holes with an equal mix of augered soil and sand.
- 3.15 DISPOSAL OF SURPLUS AND WASTE MATERIALS
- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.
 - B. Burning on Owner's property of removed trees and branches is not permitted on site.

END OF SECTION 015639

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. This 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; product substitutions; and comparable products.

1.3 DEFINITIONS

- A. Products: Items purchased 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, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, 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. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

1.4 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 3. Initial Submittal: Within thirty (30) days after date of commencement of the Work, submit three (3) copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 4. Completed List: Within sixty (60) days after date of commencement of the Work, submit three (3) copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
 5. Landscape Architect's Action: Landscape Architect will respond in writing to Contractor within fifteen (15) days of receipt of completed product list. Landscape Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Landscape Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.
- B. 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 form provided at end of Section.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications 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 substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.

- g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution 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 lack of availability or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. 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. Landscape Architect's Action: If necessary, Landscape Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. Landscape Architect will notify Contractor of acceptance or rejection of proposed substitution within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Change Order.
 - b. Use product specified if Landscape Architect cannot make a decision on use of a proposed substitution within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "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, product selected shall be compatible with products previously selected, even if previously selected products were also options.

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. 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 ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store materials in a manner that will not endanger Project structure.
2. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
3. Store cementitious products and materials on elevated platforms.
4. Store 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.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

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:** Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. **Special Warranty:** Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. **Special Warranties:** Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. **Manufacturer's Standard Form:** Modified to include Project-specific information and properly executed.
 2. Refer to Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. **Submittal Time:** Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that 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 not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Landscape Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Landscape Architect's.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
 2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
 3. Products: Where Specification paragraphs or subparagraphs titled "Products" include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturer's" include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 5. Product Options: Where Specification paragraphs titled "Product Options" indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
 6. Basis-of-Design Product: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product(s)" are included and also name a product and include a list of manufacturers, provide the specified 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 provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.

- a. Substitutions may be considered.
7. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Landscape Architect's sample. Landscape Architect's decision will be final on whether a proposed product matches.
 - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
 8. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Landscape Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
 9. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 01 for allowances that control product selection and for procedures required for processing such selections.

2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Landscape Architect will consider requests for substitution if received within thirty (30) days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Landscape Architect.
- B. Conditions: Landscape Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Landscape Architect will return requests without action, except to record noncompliance with these requirements:
 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Landscape Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's Construction Schedule.

6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. 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.

2.3 COMPARABLE PRODUCTS

- A. Conditions: Landscape Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Landscape Architect will return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION

3.1 PRODUCT SUBSTITUTION REQUEST FORM:

- A. Product Substitution Request Form is attached herewith.

END OF SECTION 016000

PRODUCT SUBSTITUTION REQUEST FORM

TO: _____

FROM: _____

PROJECT NAME: _____

LANDSCAPE ARCHITECT'S PROJECT NUMBER: _____

We hereby submit for your consideration the following product instead of the specified item for the above project:

<u>Section</u>	<u>Paragraph</u>	<u>Specified Item</u>
_____	_____	_____

Proposed Substitution: _____

Attach complete technical data, including laboratory tests, if applicable.
Include complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.

Fill in Blanks Below:

A. Does the Substitution affect dimensions shown on Drawings?

B. Will the undersigned pay for changes to the building design, including engineering and detailing costs caused by the requested substitution?

C. What affect does substitution have on other trades?

D. Differences between proposed substitution and specified item?

E. Manufacturer's warranty of the proposed and specified items are:

Same Different (explain on attachment)

F. Savings in cost and/or time: _____

The undersigned states that the function, appearance and quality are equivalent or superior to the specified item.

Submitted by:

Signature _____

Firm _____

Date _____

Telephone _____

Landscape Architect's Project Number _____

For Use By Design Consultant

Recommended For Owner to:

Accept

Accept As Noted

Do Not Accept

By _____
Consultant Signature/Owner Initial

Date _____

Remarks _____

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. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.

1.3 SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.

1.4 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. Engineer Qualifications: A professional engineer of the discipline required, registered in the state in which the Project is located, to perform required engineering services.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: 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 and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of storm sewer, and water-service piping; and underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: 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. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. 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, submit a request for information to Landscape Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

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 Landscape Architect promptly.
- B. General: Engage a land surveyor or 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 dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Landscape Architect when deviations from required lines and levels exceed allowable tolerances.
 - 6. 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 invert elevations.
- D. 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 Landscape Architect.

3.4 FIELD ENGINEERING

- A. 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 Owner. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Landscape Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two (2) 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.

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.
- 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. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Landscape Architect.
 2. 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.
- H. 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.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- K. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "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. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017329 - CUTTING AND PATCHING

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 procedural requirements for cutting and patching.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least ten 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Dates: Indicate when cutting and patching will be performed.
 - 4. Utility Services: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related 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.

- C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces 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.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials 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 match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. 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.

- B. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- C. Existing Utility Services: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

- A. 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. 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 as small as possible, neatly to 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 Division 31 Sections where required by cutting and patching operations.
 - 5. Proceed with patching after construction operations requiring cutting are complete.
- C. 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 possible. Provide materials and comply with installation requirements specified in other Sections.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate 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 eliminate evidence of patching and refinishing.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

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. This Section includes administrative and procedural requirements for project closeout, including, but not limited to, the following:
 - 1. Warranties.
 - 2. Final cleaning.
 - 3. Observation procedures.
 - 4. Project Record Documents.
 - 5. Operation and Maintenance Manuals.
 - 6. Instruction of Owner's personnel.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 4. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 - 5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - 6. Complete startup testing of systems.
 - 7. Submit test/adjust/balance records.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements, including touchup painting.
 - 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

- B. Observation: Submit a written request for site visit for Substantial Completion. On receipt of request, Landscape Architect will either proceed with site visit or notify Contractor of unfulfilled requirements. Landscape Architect will prepare the Certificate of Substantial Completion after site visit or will notify Contractor of items, either on Contractor's list or additional items identified by Landscape Architect, that must be completed or corrected before certificate will be issued.
 - 1. Repeat Site Visit: Request site visit when the Work identified in previous site visit as incomplete is completed or corrected.
 - 2. Results of completed site visit will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final site visit for determining date of Substantial Completion, complete the following:
 - 1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 - 2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Observation: Submit a written request for final site visit for acceptance. On receipt of request, Landscape Architect will either proceed with site visit or notify Contractor of unfulfilled requirements. Landscape Architect will prepare a final Certificate for Payment after site visit or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Repeat Site Visit: Request site visit when the Work identified in previous site visit(s) as incomplete is completed or corrected.

1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Landscape Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.7 PROJECT RECORD DOCUMENT

- A. General: Do not use record documents for construction purposes. Protect Project Record Documents from deterioration and loss; provide access to Project Record Documents for the Landscape Architect's reference during normal working hours.
- B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
 - 1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
 - 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 - 3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 4. Note Change Order numbers, alternate numbers, and similar identification where applicable.
 - 5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
- C. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
 - 1. Operation Data:
 - a. Emergency instructions and procedures.

- b. System, subsystem, and equipment descriptions, including operating standards.
 - c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
 - d. Description of controls and sequence of operations.
 - e. Piping diagrams.
2. Maintenance Data:
- a. Manufacturer's information, including list of spare parts.
 - b. Name, address, and telephone number of Installer or supplier.
 - c. Maintenance procedures.
 - d. Maintenance and service schedules for preventive and routine maintenance.
 - e. Maintenance record forms.
 - f. Sources of spare parts and maintenance materials.
 - g. Copies of maintenance service agreements.
 - h. Copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside to covers to receive folded oversized sheets. Identify each binder on front and spine with printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

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: Provide 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.
- 1. Complete the following cleaning operations before requesting site visit/inspection for certification of Substantial Completion for entire Project or for a portion of Project:

- a. 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.
- b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
- c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
- e. 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.
- f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- g. Clean transparent materials, including glass. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish glass, taking care not to scratch surfaces.
- h. Remove labels that are not permanent.
- i. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
- j. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
- k. Leave Project clean and ready for occupancy.

- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.2 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system
 1. Provide instructors experienced in operation and maintenance procedures.
 2. Provide instruction at mutually agreed-upon times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 3. Schedule training with Owner with at least fourteen (14) days' advance notice.
 4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:

1. System design and operational philosophy.
2. Review of documentation.
3. Operations.
4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Repair.

END OF SECTION 017700

SECTION 02 41 13 – SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 Summary:

- A. This Section includes site preparation and demolition work as specified and shown on drawings, including obtaining and paying for all construction and barricade permits necessary for execution of the Work.
- B. Refer to SECTION 31 20 00 for Earth Moving.

1.2 Quality Assurance

- A. Regulatory Requirements: Comply with applicable requirements of federal, state, and local laws, regulations and codes having jurisdiction at project site.
- B. The Contractor shall comply with all pertinent provisions of the Manual of Accident Prevention in Construction issued by the Association of Contractors of America, Inc. and the Safety and Health Regulations of Construction issued by the U.S. Department of Labor.

1.3 Job Conditions:

- A. Inspection:
 - 1. Examine areas for conditions under which work is to be performed. Report in writing to Architect all conditions contrary to those shown on the drawings or specified herein and all other conditions that will affect satisfactory execution of work such as improperly constructed substrates or adjoining work. Do not proceed with work until unsatisfactory conditions have been corrected.
 - 2. Prior to starting construction, the General Contractor shall be responsible for verifying that all required permits and approvals have been obtained. No construction or fabrication of any item shall begin until the contractor has received all plans and any other documentation from all of the permitting agencies and other regulatory authority.
 - 3. Starting work constitutes acceptance of the conditions under which work is to be performed. After such acceptance this contractor shall at his expense, be responsible for correcting all unsatisfactory and defective work resulting from such unsatisfactory conditions.
- B. Nuisances: Keep dirt, dust, noise, and other objectionable nuisances to a minimum. Use temporary enclosures, coverings and sprinkling, or combinations thereof, as necessary to limit dust to lowest practicable level, except do not use water to the extent that it causes flooding, contaminated runoff, or icing.

- C. Traffic: Conduct work to ensure minimum interference with streets, driveways, sidewalks, and access to operations of on-site facilities.
 - 1. Do not close or obstruct streets, sidewalks, drives or other public passageways without permission.
 - 2. Contractor is responsible for any damage caused by his work on this project, including damage caused by his subcontractors.
 - 3. The Contractor shall install and maintain for the duration of the project all necessary barricades and traffic control devices for the protection and safety of the public.
- D. Protections: Prevent movement and settlement of adjacent structures. Install temporary barriers, fences, guard rails, enclosures, shoring, bracing, planking, barricades, lights, warning signs and other protections required to protect structures, utilities, landscaping, and other items that are to remain in place.

PART 2 - PRODUCTS

2.1 Sediment Drainage Fabric:

- A. Silt fence must meet the requirements of Section 171 Silt Fence for the Department of Transportation, State of Georgia, standard specification, latest edition, and must be a non-biodegradable, sunlight stabilized, woven polypropylene fabric, type which will retain sediment and reduce water runoff velocity; one of the following by listed manufacturer, or approved equal:
- B. Manufacturers:
 - 1. Mirafi 100x Sedimentation Control Fabric, MIRAFI, INC.
 - 2. Propex 1325 Embankment/Erosion Control Fabric, AMOCO FABRICS COMPANY.
 - 3. Trevira Spunbond Engineering Fabric Style 1115 or 1120, HOECHST FIBERS INDUSTRIES.
 - 4. Substitutions: Comply with provisions of Conditions of the Contract.

PART 3 - EXECUTION

3.1 Erosion and Sediment Control:

- A. During construction, the Contractor shall provided for adequate drainage and proper soil erosion control measures in accordance with the Manual for Erosion and Sediment Control in Georgia, latest edition. Positive drainage shall be provided during all phases of construction.
- B. Install erosion and sediment control devices in accordance with Section 31 32 11.

- C. Additional erosion control measures will be employed where determined necessary by actual site conditions.
 - D. The Contractor shall inspect erosion control measures at the end of each working day to ensure that these measures are functioning properly. All sediment control will be maintained until the permanent vegetation and all roads and parking areas have been paved.
- 3.2 Clearing and Grubbing (refer to Section 02230)
- 3.3 Utilities:
- A. Verify locations (horizontal and vertical) and size of all utilities on site.
 - B. Cooperate with Owner, utility companies, and other building trades in maintaining and protecting utilities in work areas.
- 3.4 Demolition:
- A. General: Remove and demolish materials in orderly and careful manner. If departures from drawing requirements are deemed necessary by Contractor, submit details and reasons therefore to Architect for action. Make no departures without prior written approval. Repair or replace all demolition work performed in excess to that required, at no cost to the Owner. Repair or replacement shall match and equal construction, condition, and finish existing at time of award of contract.
 - B. Remove following from locations to extent shown on drawings:
 - 1. Concrete: Saw cut to neat line, as required to separate from existing shown to remain. Remove all existing where noted.
 - 2. Existing landscaping as required for new construction. Refer to Section 02 41 13.
 - C. Backfill and compact areas excavated, open pits and holes resulting from demolition operations. Comply with requirements specified in Section 31 20 00 for backfill materials, compaction, and installation methods.
 - D. Rough grade demolition areas, to meet adjacent contours and to provide positive drainage. Leave site in clean condition acceptable for performance of subsequent construction operations.
- 3.5 Clean-Up and Disposal:
- A. Transport trash, rubbish, and debris daily from site and legally dispose of.
 - 1. Remove and promptly dispose of contaminated, vermin infested, or dangerous materials encountered.

2. Do not burn or bury materials on site, unless otherwise approved by Architect and local authorities having jurisdiction.
- B. Remove tools, equipment, and protections when work is complete and when authorized to do so by local authorities having jurisdiction and Owner.

END OF SECTION 02 41 13

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

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. Form-facing material for cast-in-place concrete.
 - 2. Shoring, bracing, and anchoring.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at location to be determined.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction, movement, contraction, and isolation joints
 - c. Forms and form-removal limitations.
 - d. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Forms for cylindrical columns.
 - 4. Form ties.

5. Waterstops.
 6. Form-release agent.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301 (ACI 301M).
 - a. Location of construction joints is subject to approval of the Architect.
 3. Indicate location of waterstops.
 4. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
 5. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.
- C. Samples:
1. For waterstops.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC308.
- C. Field quality-control reports.
- D. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
- B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:
 - a. Wind Loads: As indicated on Drawings.
 - 1) Horizontal Deflection Limit: Not more than 1/240 of the wall height.

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
1. Provide continuous, true, and smooth concrete surfaces.
 2. Furnish in largest practicable sizes to minimize number of joints.
 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
1. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class.

1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

2.3 WATERSTOPS

- A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
 1. Profile: Flat dumbbell with center bulb.
 2. Dimensions: 6 inches by 3/8 inch thick nontapered.

2.4 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- C. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- D. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301 (ACI 301M).
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M) and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 1. Surface Finish-1.0: ACI 117 Class D, 1 inch (25 mm).

- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - 2. Locate temporary openings in forms at inconspicuous locations.
- I. At construction joints, overlap forms onto previously placed concrete not less than 12 inches (305 mm).
- J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- K. Construction and Movement Joints:
 - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 3. Place joints perpendicular to main reinforcement.
 - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls at 3 times the wall height or 25'-0" maximum.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- L. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF 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.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 4. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
 4. Secure waterstops in correct position at 12 inches (305 mm) on center.
 5. Clean waterstops immediately prior to placement of concrete.

6. Support and protect exposed waterstops during progress of the Work.

3.4 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
- B. Clean and repair surfaces of forms to be reused in the Work.
 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 1. Align and secure joints to avoid offsets.
 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 321313 “Concrete Paving” for reinforcing related to concrete pavement and walks.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at location to be determined.

1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.

B. Sustainable Design Submittals:

C. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For testing and inspection agency.
- B. Delegated Design Engineer Qualifications: Include the following:
 - 1. Experience providing delegated design engineering services of the type indicated.
 - 2. Documentation that delegated design engineer is licensed in Georgia.
- C. Welding certificates.
 - 1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.
- D. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
- E. Field quality-control reports.
- F. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch (25 mm), not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318 (ACI 318M).
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches (610 mm), whichever is greater.
 - 2. Stagger splices in accordance with ACI 318 (ACI 318M).

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement.
 - 2. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117 (ACI 117M).

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel-reinforcement placement.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at location to be determined.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Anchor rod and anchorage device installation tolerances.
 - e. Cold and hot weather concreting procedures.

- f. Concrete finishes and finishing.
- g. Curing procedures.
- h. Forms and form-removal limitations.
- i. Concrete repair procedures.
- j. Concrete protection.
- k. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- l. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement
7. Aggregates.
8. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
9. Curing materials.
10. Joint fillers.
11. Repair materials.

B. Sustainable Design Submittals:

C. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Intended placement method.
11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

- a. Location of construction joints is subject to approval of the Architect.

- E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Curing process.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing agency: Include copies of applicable ACI certificates.

- B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Bonding agents.
5. Adhesives.
6. Semirigid joint filler.
7. Joint-filler strips.
8. Repair materials.

- C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement.
7. Aggregates.
8. Admixtures:

- a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

- D. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

- E. Preconstruction Test Reports: For each mix design.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
 - 1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- C. Field Quality-Control Testing Agency Qualifications: An independent agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1 and as follows.
1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 2. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
 3. Do not use frozen materials or materials containing ice or snow.
 4. Do not place concrete in contact with surfaces less than 35 deg F (1.7 deg C), other than reinforcing steel.
 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:
1. Maintain concrete temperature at time of discharge to not exceed 95 deg F (35 deg C).
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Cementitious Materials:
1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
 2. Fly Ash: ASTM C618, Class C or F.
 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3M typical (Class 4M at waterwall) coarse aggregate or better, graded. Provide aggregates from a single source.
1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Air-Entraining Admixture: ASTM C260/C260M.
- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

E. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 1. Color:
 - a. Ambient Temperature Below 50 deg F (10 deg C): Black.
 - b. Ambient Temperature between 50 deg F (10 deg C) and 85 deg F (29 deg C): Any color.
 - c. Ambient Temperature Above 85 deg F (29 deg C): White.
- D. Curing Paper: 8-foot- (2438-mm-) wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B.
- H. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating.
- I. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
- J. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.4 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.5 REPAIR MATERIALS

- A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

2.6 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Silica Fume: 10 percent by mass.

4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing admixture 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 water-reducing admixture in concrete with a w/cm below 0.50.

2.7 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings and walls.

1. Exposure Class: ACI 318 (ACI 318M) F1 S0 W1 C1.
2. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
3. Maximum w/cm: 0.40.
4. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm) before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Air Content:
 - a. Exposure Class F1: 4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch (25-mm) nominal maximum aggregate size.
6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF 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.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 3. Space vertical joints in walls 8'-0" tall or less at 3 times the height of the wall and for walls between 8'-0" and 12'-0" at 2 times the height of the wall. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- E. 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. Do not place concrete floors and slabs in a checkerboard sequence.
 - 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 3. Maintain reinforcement in position on chairs during concrete placement.
 - 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 5. Level concrete, cut high areas, and fill low areas.
 - 6. Slope surfaces uniformly to drains where required.
 - 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 - 8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

- 1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1 inch (25 mm).
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
 - e. Apply to concrete surfaces not exposed to public view.

B. Related Unformed Surfaces:

- 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
- 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

- 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
- 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
- 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.8 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Begin curing immediately after finishing concrete.
 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).

- b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
- 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 (300 mm), and sealed by waterproof tape or adhesive.
- a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
- a) Water.
 - b) Continuous water-fog spray.

3.9 TOLERANCES

- A. Conform to ACI 117 (ACI 117M).

3.10 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month(s).
 - 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

- 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 (13 mm) in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch (19 mm).
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with 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 matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces:
1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 3. After concrete has cured at least 14 days, correct high areas by grinding.
 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 5. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.

- c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
 6. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.

- 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of three 6-inch (150 mm) by 12-inch (300 mm) or 4-inch (100 mm) by 8-inch (200 mm) cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure two sets of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of three laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. Test one set of three field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301 (ACI 301M), Section 1.6.6.3.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.13 PROTECTION

- A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 040513 – MORTAR AND GROUT

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 mortar and grout for unit masonry:

1.3 DEFINITIONS

- A. Mortar: Composed of water, sand and cementitious materials, is placed between masonry units (joints) as they are laid to form a integrated structural assembly.
- B. Grout: Composed of water, portland cement and aggregates, is mixed to a highly fluid consistency to be poured into the cores or cavities of unit masonry construction.

1.4 SUBMITTALS

- A. Section Cross Reference: Refer to Division 01 Submittals section for general requirements.
- B. Product Data: Submit manufacturer's product data, for information only, for each manufactured product including; specifications, mixing and installation instructions.
- C. Samples for Initial Selection: Colored mortar showing the full range of colors available.
- D. Samples for Verification: Colored mortar for each color required showing the full range of colors expected in the finished construction. Make samples using the same sand and mortar ingredients to be used on the Project. Label samples to indicate type and amount of pigments used.
- E. Material Test Reports: From a qualified testing agency, employed and paid by contractor or manufacturer, indicating and interpreting test results of the following for compliance with requirements indicated:
 - 1. Mix design for mortar using proportion specification of ASTM C270.
 - 2. Grout mix design complying with compressive strength requirements of ASTM 476. Include description of type and properties of grout ingredients.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.
- C. Preconstruction Testing Service: Engage a qualified independent testing agency to perform the following pre-construction testing:
 - 1. Grout Test: For comprehensive strength per ASTM C 1019.
- D. Field Constructed Mock-Ups: Prior to installation of work, install mortar and grout in field constructed mock-up as called for in related sections.
 - 1. Acceptance of mock-ups is for relationship of mortar showing the full range of colors available.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Maintain sand for volume proportioning of mortar and grout in a damp, loose condition.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Follow requirements of ACI 530.1/ASCE6/TMS602 for cold and hot weather construction.

PART 2 - PRODUCTS

2.1 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II. Provide natural color or white cement as required to produce mortar color indicated.
 - 1. For pigmented mortar, use a colored cement formulation as required to produce color indicated, or, if not indicated, as selected from manufacturer's standard formulation.
 - a. Pigments shall not exceed ten (10) percent of portland cement by weight for mineral oxides.
- B. Masonry Cement: ASTM C 91, Type S, Gray.

1. For pigmented mortars, use a colored cement formulation as required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulation.
 - a. Pigments shall not exceed five (5) percent of masonry cement by weight for mineral oxides nor one (1) percent for carbon black.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or II, and hydrated lime complying with ASTM C 207.
- E. Aggregates for Mortar: ASTM C 144; except for joints less than one-fourth (1/4) inch (6.5 mm) thick, use aggregate graded with one-hundred (100) percent passing the No. 16 (1.18-mm) sieve.
- F. Aggregates for Grout: ASTM C 404.
- G. Ready-Mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified in this Article, combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C 1142.
- H. Non-Shrink Grout: Provide prepackaged, non metallic, non gaseous shrinkage resistant grout. Test in accordance with ASTM C 1107.
 1. Characteristics: High-flow, non-metallic, controller expansive type grout.
- I. Water: Clean, potable, free from deleterious amounts of alkalis, acids, and organic materials.
- J. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

2.2 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures. Do not lower the freezing point of mortar by use of admixtures or anti freeze agents. Do not use calcium chloride in mortar or grout.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.
 1. Extended-Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.
 2. Mortar Proportions:

Type	Portland Cement	Hydrated Lime/ Lime Putty	Masonry Cement	Maximum Damp Loose Aggregate	Minimum Compressive Strength 2" cubes @ 28 days, ASTM C270 (psi)
	(cu. ft.)	(cu. ft.)		(cu. ft.)	
S	1	1/4 to 1/2	----	3-3/8 to 4-1/2	1800
S	----	----	1	2-1/4 to 3	1800

- a. The weight of one (1) cubic foot of materials is considered to be: Portland Cement 94 lbs. (one (1) bag); hydrated lime, 40 lbs.; lime putty, 80 lbs.; dry sand, 80 lbs.; masonry cement, weight printed on bag.
- b. For each type of mortar, the figures above the line show proportions for portland cement lime mortar. Mortars made with masonry cement are shown below the line.
- c. Damp, loose aggregate shall not be less than two and one-fourths (2¼) times, nor more than three (3) times, the cementitious material used, as measured by volume.

C. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required

1. Limit pigments to the following percentages of cement content by weight:
 - a. For mineral oxide pigments and portland cement-lime mortar, not more than ten (10) percent
 - b. For mineral oxide pigments and masonry-cement mortar, not more than five (5) percent.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Minimum Compressive Strength: 2500 psi at twenty-eight (28) days.
2. Use grout of type indicated, or, if not otherwise indicated, of type that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
3. Provide grout with a slump of eight to eleven (8-11) inches (200 to 280 mm) as measured according to ASTM C 143.
4. Grout Proportions:

Type	Portland Cement or Blended Cement Slag Cement	Hydrated Lime or Lime Putty	Maximum Damp Loose Aggregate Fine	Course
	(cu. ft.)	(cu. ft.)	(cu. ft.)	
Fine	1	0 to 1/10	2-1/4 to 3	None
Coarse	1	0 to 1/10	2-1/4 to 3	1 to 2

- a. Fine aggregate in grout measured in damp, loose condition shall be two and one-fourths to three (2¼-3) times the sum of the volume of the cementitious materials.
- b. Course aggregate in grout measured in damp, loose condition shall be one to two (1-2) times the sum of the volume of the cementitious materials.

- E. Non shrink grout: Mix prepared non shrink grout product with water as directed by manufacturer's product data to achieve a minimum compressive strength of 3000 psi at twenty-eight (28) days.
- F. Pointing Mortar: Three (3) part clean masonry sand to one (1) part Portland cement with admixture following manufacturer's recommendations.

PART 3 - EXECUTION

3.1 MIXING

- A. Measure materials for job-mixed mortars by volume or equivalent weight. Do not measure by shovels.
- B. Mix mortar in clean, power driven, drum type mixers. Operate mixer three to five (3-5) minutes after addition of all materials.
- C. Mix grout in accordance with ASTM C 94.
- D. Measure grout materials mixed at jobsite by volume and mix all ingredients in mechanical mixer for minimum of five (5) minutes.
- E. For job-mixed mortars add water reducing and plasticizing admixture in accord with admixture manufacturer's product data.
- F. Addition of other admixtures, including anti freeze ingredients, will not be permitted.
- G. Discard grout not placed within one to one-half (1-1½) hours after water is added to mix, or sooner as indicated by grout manufacturer.

3.2 PLACING MORTAR AND GROUT

- A. Install mortar and grout in accordance with ACI 530.1/ASCE6/TMS602.
- B. Re-temper mortar as necessary to keep plastic. Use no mortar after setting has begun or after two and one-half (2½) hours of initial mixing.
- C. Keep bed uniform in width, except for minor variations required to maintain bond. Standard thickness for horizontal mortar joints shall be one-half (1/2) inch unless otherwise indicated on Drawings.
- D. Adjustment shall be made only while mortar is still soft and plastic by tapping to plumb and bringing to alignment. Remove until and relay in fresh mortar when unit must be pulled back to align.
 - 1. Where adjustment must be made after mortar has started to set, remove and replace mortar with fresh mortar.

END OF SECTION 040513

SECTION 042000 - UNIT MASONRY ASSEMBLIES

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 unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMUs).
 - 2. Face brick.
 - 3. Building (common) brick.
 - 4. Mortar and grout.
 - 5. Reinforcing steel.
 - 6. Masonry joint reinforcement.
 - 7. Ties and anchors.
 - 8. Miscellaneous masonry accessories.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Dovetail slots for masonry anchors, installed under Division 03 Section "Cast-in-Place Concrete."
- C. Products installed, but not furnished, under this Section include the following:
 - 1. Cast-stone trim, furnished under Division 04 Section "Cast Stone Masonry."
 - 2. Steel lintels and shelf angles for unit masonry, furnished under Division 05 Section "Metal Fabrications."

1.3 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 SUBMITTALS

- A. Section Cross Reference: Refer to Division 01 Submittals Section for general requirements.
- B. Product Data: For each type of product indicated. For each different masonry unit, accessory, and other manufactured product specified, for information only.
- C. Shop Drawings: Show fabrication and installation details for the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

D. Samples for Initial Selection: For the following:

1. Face brick, in the form of straps of five or more bricks.
2. Colored mortar samples showing full range of colors available.

E. Samples for Verification: For each type and color of the following:

1. Face brick, in the form of straps of five or more bricks.
2. Special brick shapes.
3. Pigmented mortar samples for each color required showing full range of colors expected in the finished construction. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
4. Weep holes/vents in color to match mortar color.
5. Accessories embedded in masonry.

F. Material Certificates: Include statements of material properties, signed by the manufacturer, indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Each type of masonry units required.
 - a. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
2. Cementitious materials required for mortar and grout. Include brand, type, name of manufacturer and weight slips at time of delivery.
3. Each material and grade indicated for reinforcing bars.
4. Each type and size of joint reinforcement.
5. Each type and size of anchors, ties, and metal accessories.

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, through one source from a 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 a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- C. Mockups: Before installing unit masonry, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work.

1. Locate mockups in the locations indicated or, if not indicated, as directed by Landscape Architect.
2. Build mockup of typical wall area as shown on Drawings.
3. Build mockups for each type of exposed unit masonry construction in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness, including face and backup wythes and accessories.
4. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
5. Clean exposed faces of mockups with masonry cleaner as indicated.
6. Protect accepted mockups from the elements with weather-resistant membrane.
7. 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 is also for other material and construction qualities specifically approved by Landscape Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Landscape Architect in writing.
8. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
9. Notify Landscape Architect seven (7) days in advance of dates and times when mockups will be constructed.
10. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

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. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT 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 (600 mm) down both sides and hold cover securely in place.
 2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover 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 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 ACI 530.1/ASCE 6/TMS 602.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
1. When ambient temperature exceeds 100 deg F (38 deg C) or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13km/h), do not spread mortar beds more than forty-eight (48) inches (1200 mm) ahead of masonry. Set masonry units within one (1) minute of spreading mortar.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.2 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide shapes indicated and as follows:
1. Provide special shapes for lintels, corners, movement joints, headers, bonding, and other special conditions.
 2. Provide bullnose units for outside corners, where indicated.
- B. Concrete Masonry Units: ASTM C 90, and as follows:
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
 2. Weight Classification: Normal weight, unless otherwise indicated.
 3. Provide Type I, moisture-controlled units.
 4. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 5. Size (Width): Manufactured to the following dimensions:
 - a. 4 inch (100 mm) nominal; 3-5/8 inch (92 mm) actual.
 - b. 6 inch (150 mm nominal); 5-5/8 inch (143 mm) actual.
 - c. 8 inch (200 mm nominal); 7-5/8 inch (194 mm) actual.
 - d. 10 inch (250 mm nominal); 9-5/8 inch (244 mm) actual.
 - e. 12 inch (300 mm nominal); 11-5/8 inch (295 mm) actual.

2.3 BRICK

- A. General: Provide shapes indicated and as follows:
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.
 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: ASTM C 216, Grade SW, Type FBS, and as follows:
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi (20.7 MPa).
 2. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
 3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 4. Size (Actual Dimensions): 3-1/2 inches (89 mm) wide by 2-1/4 inches (57 mm) high by 7-1/2 inches (190 mm) long or 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
 5. Application: Use where brick is exposed, unless otherwise indicated.
 6. Color and Texture: Match Landscape Architect's samples.

- C. Building (Common) Brick: ASTM C 62, Grade SW, and as follows:
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi (20.7 MPa).
 2. Size: Match size of face brick.
 3. Size (Actual Dimensions): 3-1/2 inches (89 mm) wide by 2-1/4 inches (57 mm) high by 7-1/2 inches (190 mm) long or 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
 4. Application: Use where brick is indicated for concealed locations. Face brick complying with requirements for grade, compressive strength, and size indicated for building brick may be substituted for building brick.

2.4 MORTAR AND GROUT MATERIALS

- A. Section Cross Reference: Refer to Division 04 Masonry, Mortaring and Grouting Section for requirements.
- B. 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.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- E. Masonry Cement: ASTM C 91.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
- G. Aggregate for Mortar: ASTM C 144.
1. For joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
- H. Aggregate for Grout: ASTM C 404.
- I. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Landscape Architect from manufacturer's colors.
- J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
- K. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996; Grade 60.
- B. Epoxy-Coated Reinforcing Steel: ASTM A 615, Grade 60; epoxy coated to comply with ASTM A 775.
- C. Masonry Joint Reinforcement, General: ASTM A 951.
 - 1. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 2. Wire Size for Side Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
 - 3. Wire Size for Cross Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
 - 4. Wire Size for Veneer Ties: W1.7 or 0.148-inch (3.8-mm) diameter.
 - 5. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.
- D. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods and across rods spaced not more than sixteen (16) inches (407) o.c.
- E. Masonry Joint Reinforcement for Multiwythe Masonry:
 - 1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches (100 mm) in width, plus 1 side rod at each wythe of masonry 4 inches (100 mm) or less in width.
 - 2. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties have two hooks that engage eyes or slots in reinforcement and resist movement perpendicular to wall. Ties extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.

2.6 TIES AND ANCHORS, GENERAL

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
 - 2. Stainless-Steel Wire: ASTM A 580, Type 304.
 - 3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153.
 - 4. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 5. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Corrugated Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from stainless-steel sheet not less than 0.067 inch (1.7 mm) thick.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
 2. Where wythes do not align, use adjustable ties composed of two (2) parts; one (1) with pintles, the other with eyes connections having a maximum adjustment of 1-1/4 inches (32 mm).
 3. Wire: Fabricate from 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel wire.
- D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.
 3. Connector Section for Concrete: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.053-inch- (1.3-mm-) thick, steel sheet, galvanized after fabrication.
 4. Tie Section for Concrete: Corrugated metal ties with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch (25 mm) of masonry face.
- E. Partition Top anchors: 0.097-inch- (2.5-mm-) thick metal plate with 3/8-inch- (10-mm-) diameter metal rod 6 inches (150 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate stainless steel.
- F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.4 mm) thick by 24 inches (600 mm) long, with ends turned up 2 inches (50 mm) or with cross pins, (unless otherwise indicated) bent to configuration indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153.
- G. Stone Anchors: Fabricate dowels, cramps, and other stone anchors from stainless steel.

2.7 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts of type and size indicated.
- B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch (0.9-mm), galvanized steel sheet.
- C. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of dimensions indicated and in the following configurations:
 1. Headed bolts.
 2. Nonheaded bolts, bent in manner indicated.
- D. Postinstalled Anchors: Provide torque-controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit

masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Type: Expansion anchors.
2. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
3. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304, for anchors.
4. For Post-Installed Anchors in Concrete: Capability to sustain, without failure, a load equal to four (4) times the load imposed.

2.8 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 or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
 1. Styrene-Butadiene-Rubber Compound: ASTM D 2000, Designation M2AA-805.
 2. PVC: ASTM D 2287, Type PVC-65406.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.9 MASONRY CLEANERS

- A. Job-Mixed Detergent Solution: Solution of 1/2 cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2 cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.
- B. 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.

2.10 MORTAR AND GROUT MIXES

- A. Section Cross Reference: Refer to Division 04, Masonry, Mortaring and Grouting Section for requirements.
- B. 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. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
 3. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement, mortar cement, and lime.
 4. 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.
- C. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- D. 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 or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type S.
- E. 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 Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143.

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 work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. 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 cut with water-cooled saws to dry before placing unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- E. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
 - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
 - 2. 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.
 - 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
 - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
 - 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
 - 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.
 - 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.3 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. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. 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 racking 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. 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.
- F. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units 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. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.5 COMPOSITE MASONRY

- A. Bond wythes of composite masonry together using one of the following methods:
 - 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m) of wall area spaced not to exceed 36 inches (914 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
 - 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints to bond wythes together.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.

- B. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.
 - 1. Provide continuity with masonry joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.
- C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
 - 1. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.

3.6 CAVITY WALLS

- A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
 - 1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.
- B. Coat cavity face of backup wythe to comply with Division 07 Section "Bituminous Dampproofing."

3.7 MASONRY JOINT REINFORCEMENT

- A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
 - 1. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.
- 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 corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch (25 mm) in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.9 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
1. Fasten anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 2. Embed tie sections, connector sections and continuous wire in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 4. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 32 inches (813 mm) o.c. horizontally with not less than 1 anchor for each 3.5 sq. ft. (0.33 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

3.10 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry where indicated. Build-in related items 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 as follows:
1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
- C. Form expansion joints in brick made from clay or shale as follows:
1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches (100 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
 3. Build in compressible joint fillers where indicated.
 4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants." Maintain joint free and clear of mortar.

3.11 WEEP HOLES, CAVITY DRAINAGE, 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. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Place pea gravel in cavities as soon as practical to a height equal to height of first course above finished grade, but not less than 2 inches (50 mm), to maintain drainage.

3.12 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 Landscape Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20, using job-mixed detergent solution.
 - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
 - 8. Clean stone trim to comply with stone supplier's written instructions.
 - 9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.13 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at Date of Substantial Completion.

3.14 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. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 047200 - CAST STONE MASONRY

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. Cast stone trim.
 - a. Wall caps.

1.3 DEFINITIONS

- A. Cast Stone: Architectural precast concrete building units intended to simulate natural cut stone.

1.4 SUBMITTALS

- A. Section Cross Reference: Refer to Division 01 Submittals Section for general requirements.
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for cast stone units, for information only.
- C. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
 - 1. Include elevations showing layout of units and locations of joints and anchors.
- D. Samples for Initial Selection: For colored mortar; showing the full range of colors available.
- E. Samples for Verification:
 - 1. For each color and texture of cast stone required, 10 inches (250 mm) square in size.
 - 2. For colored mortar. Make Samples using same sand and mortar ingredients to be used on Project.
- F. Full-Size Samples: For each type of cast stone unit required.
 - 1. Make available for Landscape Architect's review at Project site before installing cast stone or at manufacturing plant, if acceptable to Landscape Architect.
 - 2. Make Samples from materials to be used for units used on Project immediately before beginning production of units for Project.

3. Approved Samples may be installed in the Work.

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 architects and owners, and other information specified.

1. Include copies of material test reports for completed projects, indicating compliance of cast stone with ASTM C 1364.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, with sufficient production capacity to manufacture required units and with a record of successful in-service performance.

1. Manufacturer is a producing member of the Cast Stone Institute.

B. Source Limitations for Cast Stone: Obtain cast stone units through one source from a single manufacturer.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone with unit masonry work to minimize the need for on-site storage and to avoid delaying the Work.

B. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.

2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

C. Store installation materials on elevated platforms, under cover, and in a dry location.

D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.7 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until cast stone has dried, but not less than 7 days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.8 COORDINATION

- A. Coordinate production and delivery of cast stone with unit masonry work to minimize the need for on-site storage and to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364 and the following:
- B. Portland Cement: ASTM C 150, Type I, containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation as needed to produce required textures and colors as needed to produce required cast stone colors.
- D. Fine Aggregates: Manufactured or natural sand or crushed stone complying with ASTM C 33, gradation as needed to produce required textures and colors as needed to produce required cast stone colors.
- E. 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.
- F. Admixtures: Do not use admixtures unless specified or approved in writing by Architect.
 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
 3. Air-Entraining Admixture: ASTM C 260, certified by the manufacturer to be compatible with other admixtures used. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent.
 4. Water-Reducing Admixture: ASTM C 494, Type A.
 5. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
 6. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.
- G. Reinforcement: Deformed steel bars complying with ASTM A 615. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches (38 mm) of cast stone material.
 1. Epoxy Coating: ASTM A 775.

2. Galvanized Coating: ASTM A 767.

H. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A 276, or ASTM A 666, Type 304.

2.2 CAST STONE UNITS

A. Provide cast stone units complying with ASTM C 1364.

1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666, Procedure A, as modified by ASTM C 1364.

B. Fabricate units with sharp arris and details accurately reproduced with indicated texture on all exposed surfaces, unless otherwise indicated.

1. Slope exposed horizontal surfaces at least 1:12, unless otherwise indicated.
2. Provide drips on projecting elements, unless otherwise indicated.

C. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch (3 mm).
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater, but in no case by more than 1/4 inch (6 mm).
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch (3 mm) on formed surfaces of units and 3/8 inch (10 mm) on unformed surfaces.

D. Cure units by one of the following methods:

1. Cure units with dense fog and water spray in enclosed warm curing room at 95 to 100 percent relative humidity for 24 hours.
2. Yard cure units until the sum of the mean daily temperatures for each day equals or exceeds 350 deg F.

E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

F. Colors and Textures: As selected by Landscape Architect from manufacturer's full range.

G. Color and Texture: Provide units with fine-grained texture and buff color resembling Indiana limestone.

H. Reinforce units as indicated and as required by ASTM C 1364. Use galvanized or epoxy-coated reinforcement when covered with less than one and one-half (1 ½) inches (38 mm) of material.

2.3 MORTAR 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. For pigmented mortars, use colored portland cement-lime mix of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed ten (10) percent of portland cement by weight for mineral oxides or two (2) percent for carbon black.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
- E. Aggregate for Mortar: ASTM C 144.
 - 1. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 2. Colored-Mortar Aggregates: Natural sand, crushed stone or ground marble, granite or other sound stone, of color necessary to produce required mortar color, as required matching Landscape Architect's sample.
- F. Water: Potable.

2.4 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from stainless steel complying with ASTM A 240, ASTM A 276, or ASTM A 666, Type 304.
- B. Dowels: Round stainless-steel bars complying with ASTM A 276, Type 304, and 1/2-inch (12-mm) diameter.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.
- D. Job-Mixed Detergent Solution: Solution of one-half (1/2) cup (125 mL) of dry-measure tetrasodium polyphosphate and one-half (1/2) cup (125 mL) of dry-measure laundry detergent dissolved in one (1) gallon (4 L) of water.

2.5 MORTAR MIXES

- A. 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.
 2. Limit cementitious materials in mortar to portland cement and lime.
- B. Comply with ASTM C 270, Proportion Specification.
1. For setting mortar, use Type S.
 2. Packaged Portland Cement-Lime Mix Mortar: Use portland cement-lime mix of selected color.
 3. Colored-Aggregates Mortar: Produce color required by combining colored aggregates with portland cement of selected color.

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 cast stone.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING CAST STONE IN MORTAR

- A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
- B. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- C. Set units in full bed of mortar with full head joints, unless otherwise indicated.
1. Build anchors and ties into mortar joints as units are set.
 2. Fill dowel holes and anchor slots with mortar.
 3. Fill collar joints solid as units are set.
 4. Keep head joints in coping and other units with exposed horizontal surfaces open, clear of mortar and raked out to receive sealant.
- D. Rake out joints for pointing with mortar to depths of not less than 3/4 inch (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- E. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- F. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

- G. Provide isolation, control, and pressure-relieving joints of widths and at locations indicated. Keep joints free of mortar and other rigid materials.
 - 1. Section Cross Reference: Refer to Division 07, Joint Sealants Section, for sealant joints.
 - 2. Keep joints free of mortar and other rigid materials.

3.3 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.
- B. Keep cavities open where unfilled space is indicated between back of cast stone units and backup wall; do not fill cavities with mortar or grout.
- C. Fill anchor holes with sealant.
 - 1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- D. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.
- E. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.
 - 1. Section Cross Reference: Refer to Division 07, Joint Sealants Section, for sealant joints.

3.4 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch (1.5 mm).

3.5 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Landscape Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
 - 1. Remove mortar fins and smears before tooling joints.
 - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Landscape Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
 - 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - 5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20 Revised II, using job-mixed detergent solution.
 - 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 055213 - PIPE AND TUBE RAILINGS

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 railing systems:
 - 1. Steel pipe and tube handrails and railings.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design handrails and railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering handrails and railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
- C. Structural Performance: Handrails and railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, without exceeding the allowable design working stress of the materials for railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising railing systems.
 - 1. Handrails and Top Rails of Guards: Capable of withstanding the following loads applied as indicated:
 - 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 at any point and in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Uniform load of 25 lbf/sq.ft. (1.2 kN/sq.m) applied horizontally.
 - c. Infill load and other loads need not be assumed to act concurrently.

- D. Thermal Movements: Provide exterior handrails and railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

- A. Section Cross Reference: Refer to Division 01 Submittals Section for general requirements.
- B. Product Data: For the following, for information only:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- C. Shop Drawings: Show fabrication and installation of handrails and railings. Include plans, elevations, sections, details of components, and attachments to other work.
- D. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes on stainless steel.
 - 1. Manufacturer's color charts showing full range of colors available for products with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, prepared on components indicated below and of same thickness and metal indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - 1. Sections, six (6) inches long, of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Fittings and brackets.
- F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- G. Qualification Data: For qualified professional engineer.
- H. Welding certificates: Submit written documentation certifying that welders comply with requirements of "Welding Qualifications" below.

- I. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- J. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. Certification: Certify that each welder has satisfactorily passed AWS qualification tests for welding process involved and, if pertinent, has gone under recertification.
- C. Professional Engineer Qualifications: Engage a professional engineer legally qualified to practice in the jurisdiction where the Project is located and experienced in providing services of the kind indicated for handrails and railing systems of the same materials, design and of similar size and scope of work to that indicated for this Project. The professional engineer's stamp shall appear on shop drawing submittals including drawings and design calculations.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
- B. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry for installation of metal work. Provide setting drawings templates, instructions and directions for installation of inserts and anchoring devices. Provide so as not to cause delay of work.

1.7 COORDINATION AND SCHEDULING

- 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 handrails and 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.

1.8 STORAGE

- A. Store handrails and railings in a clean, dry, well-ventilated, weather-tight place.

PART 2 - PRODUCTS

2.1 SOURCE QUALITY CONTROL

- A. Single Source Responsibility: Obtain handrails and railings of each type and material from a single manufacturer.

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, or other imperfections where exposed to view on finished units.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than **25** percent.
- B. Tubing: ASTM A 500 (cold formed) **or** ASTM A 513.
- C. Plates, Shapes, and Bars: ASTM A 36.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Handrails and Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Handrails and Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153 or ASTM F 2329 for zinc coating.
- B. Fasteners for Anchoring Handrails and 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 otherwise indicated.
 - 2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled or cast-in-place expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit

masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum and stainless-steel handrails and railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- 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. 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.
- E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- F. Shop Primer for Galvanized Steel: Water based galvanized metal primer complying with MPI#134.
- G. Intermediate Coats and Topcoats: Provide products that comply with Division 09 painting Sections and Division 09 Section "High-Performance Coatings."
- H. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- I. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- J. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- K. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

- A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes, including wall thickness of hollow members, and post spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble handrails and railings in the shop 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. Clearly mark units for reassembly and coordinated installation.

- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs from exposed cut edges and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing Work.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude 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 handrails and railings with welded connections unless otherwise indicated.
- H. Welded Connections: Fabricate railings and handrails for connecting members by welding. Cope components at perpendicular and skew 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 of railing members as follows:
 - 1. By radius bends of radius indicated.
- K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cylindrical 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. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

- N. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide preset **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.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of handrails and railings.

2.8 STEEL

- A. Galvanized Handrails and Railings:
 - 1. Hot-dip galvanize exterior steel handrails and railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123 for hot-dip galvanized handrails and railings.
 - 3. Comply with ASTM A 153 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 necessary for galvanizing that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized handrails and railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Handrails and Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. For nongalvanized steel handrails and railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with [SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" and SSPC-SP 3, "Power Tool Cleaning." requirements indicated below:
 - 1. Exterior Handrails and Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Handrails and Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Handrails and Railings Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Handrails and Railings: SSPC-SP 3, "Power Tool Cleaning."

- F. Primer Application: Apply shop primer to prepared surfaces of handrails and railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer shall be applied to surfaces to be embedded in concrete or masonry.
 - 1. Shop prime uncoated handrails and railings with primers specified in Division 09 Painting Sections.

- G. Shop-Painted Finish: Comply with Division 09 Section "Exterior Painting."
 - 1. Color: As selected by Landscape Architect from manufacturer's full range.

- H. Finish System: Apply finish system, as indicated, on all ferrous metal surfaces exposed to view.
 - 1. Refer to Division 09 "Exterior Painting" or "High Performance Coatings" Section for requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Anchors and Inserts: Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete as masonry construction. Coordinate deliver of such items to Project site.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.

- B. Cutting, Fitting and Placement: Perform cutting, drilling, and fitting required for installing handrails and railings. Set handrails and 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 have been 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 (5 mm in 3 m).
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint or zinc chromate primer.
- D. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and 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 handrails and 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.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post. For installations exposed on exterior or to flow of water, seal anchoring material to comply with grout manufacturer's directions.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

3.6 ADJUSTING AND CLEANING

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 PROTECTION

- A. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 057300 - DECORATIVE METAL RAILINGS

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. Steel and iron ornamental handrails and railings.

1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.4 PERFORMANCE REQUIREMENTS

- A. General: In engineering handrails and railings to withstand structural loads indicated, determine allowable design working stresses of materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
- B. Structural Performance of Handrails and Railing Systems: Provide handrails and railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, without exceeding the allowable design working stress of the materials for handrails, railings, anchors and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.
 - 1. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
 - 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: Capable of withstanding the following loads applied as indicated:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied horizontally and concurrently with 100 lbf/ ft. (1.46 kN/m) applied vertically downward.
 - 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.

3. Infill of Guards:
 - a. Concentrated load of 200 lbf (0.89 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Uniform load of 25 lbf/sq. ft. (1.2 kN/sq. m) applied horizontally.
 - c. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Provide exterior handrails and railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

- A. Section Cross Reference: Refer to Division 01 Submittals Section for general requirements.
- B. Product Data: For the following, for information only:
 1. Manufacturer's product lines of handrails and railings assembled from standard components.
 2. Grout, anchoring cement, and paint products.
- C. Shop Drawings: Show fabrication and installation of handrails and railings. Include plans, elevations, sections, details, and attachments to other work.
 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Samples for Initial Selection: For products involving selection of color, texture, or design. Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, prepared on components indicated below of same thickness and metal indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 1. Six (6) inch long sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 2. Each type of glass required.
 3. Fittings and brackets.
 4. Welded connections.

5. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.
- F. Qualification Data: Submit written documentation certifying that Installer complies with requirements of "Installer Qualification" below.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according ASTM E 894 and ASTM E 935.
- H. Manufacturer's Certification: Submit written documentation certifying that handrail and railings meet specified requirements and that they are installed in accordance with manufacturer's written instructions and as specified herein.

1.6 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: Engage a professional engineer legally qualified to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of handrails and railing systems similar to this Project in material, design, and extent and that have a record of successful in-service performance.
- B. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations: Obtain each type of railing through one source from a single manufacturer.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. 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. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.
- E. Product Options: Drawings indicate size, profiles, and dimensional requirements of handrails and railings and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
 1. Do not modify intended aesthetic effects, as judged solely by Landscape Architect, except with Landscape Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Landscape Architect for review.
- F. Preconstruction Testing Service: Engage a qualified independent testing agency to test handrails and railings according ASTM E 894 and ASTM E 935 for compliance with specified requirements for performance.
 1. Provide test specimens and assemblies representative of proposed materials and construction.
 2. Fabricate and install test assemblies using personnel who will perform the same tasks for Project.

3. Select sizes and configurations of assemblies to adequately demonstrate capability of handrails and railings to comply with performance requirements.
 4. When testing is complete, remove assemblies; do not reuse materials on Project.
- G. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
- H. Field Constructed Mockups: Prior to installing railings, construct mockups for each form of railing system and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and workmanship to be expected in completed work. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.
1. Locate mockups on site in the location and of the size indicated or, if not indicated, as directed by the Landscape Architect.
 2. Obtain Landscape Architect's acceptance of mockups before start of final unit of Work.
 3. Replace unsatisfactory mockup work; as directed, until acceptable to Landscape Architect.
 4. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work. Do not alter, move or destroy mockup until work is completed. The approved mockup in undisturbed conditions at Date of Substantial Completion may be a portion of the Work and remain in place.
- I. Installer Qualifications: Engage a firm specializing in ornamental handrails and railing work. Installer shall have successfully completed at least thirty (30) handrails and railing installation projects of the same materials and of similar size and scope of work to that indicated for this Project and that have a record of successful in-service performance.
1. Firm Experience Period: Ten years minimum.
 2. Installer Acceptance: Installer shall be acceptable to handrail and railing manufacturer.
- J. Manufacturer's Responsibility: Manufacturer shall provide technical services of an authorized representative during the installation of the Work for construction concerning project requirements.
- 1.7 STORAGE
- A. Store handrail and railings in a dry, well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- 1.8 PROJECT CONDITIONS
- A. Field Measurements: Verify actual locations of walls and other construction contiguous with handrails and railings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- B. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry for installation of handrail and railing work. Provide setting drawings, templates, instructions and directions for installation of inserts and anchorage devices. Provide so as not to cause delay of Work.

1.9 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for handrails and 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.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support handrails and railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 SOURCE QUALITY CONTROL

- A. Single-Source Responsibility: Obtain handrails and railings of each type and material from a single manufacturer.

2.2 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:

2.3 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: Same metal and finish as supported rails, unless otherwise indicated.

2.4 STEEL

- A. Tubing: ASTM A 500 (cold formed).
- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A 36.

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
 - 2. Galvanized Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
 - 3. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring Handrails and Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring handrails and railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting handrail and railing components and for attaching handrails and railings to other work, unless otherwise indicated.
- D. Anchors: Provide cast-in-place or torque-controlled expansion anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.6 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
 - 1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
 - 3. Coordinate shop primer compatibility with finish paint systems prior to applying shop primer.
 - 4. Refer to Division 09 "Exterior Painting" or "High Performance Coatings" sections for requirements.
- B. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for exterior applications.

2.7 FABRICATION

- A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes, including wall thickness of hollow members, post spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble handrails and railings in the shop 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 from exposed cut edges and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate to drain entrapped water in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. 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.
- H. Mechanical Connections: Fabricate railings and handrails by connecting members with railing manufacturer's standard concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- I. Form changes in direction of railing members as follows:
 - 1. By radius bends of radius indicated.
- J. Form simple and compound curves by bending members in 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 handrail and railing components.

- K. Close exposed ends of hollow handrail and railing members with prefabricated end fittings.
- L. 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.
- M. Brackets, Flanges, Fittings, and Anchors: Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.
- N. Provide inserts and other anchorage devices for connecting handrail and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.
- O. 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 (12 mm) greater than outside dimensions of post, with steel plate forming bottom closure.

2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STEEL FINISHES

- A. Galvanized Handrails and Railings:
 - 1. Hot-dip galvanized exterior steel and iron handrails and railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized handrails and railings.
 - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
- B. Fill vent and drain holes necessary for galvanizing that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. For galvanized handrails and railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- D. For nongalvanized steel handrails and railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

- E. Preparation for Shop Priming: After galvanizing, thoroughly clean handrails and railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.
- F. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed handrails and railings:
 - 1. Exterior Handrails and Railings (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- G. Apply shop primer to prepared surfaces of handrails and railings, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer shall be applied to surfaces to be embedded in concrete or masonry.
 - 1. Do not apply primer to galvanized surfaces.
 - 2. Apply primer to galvanized surfaces as recommended by final paint finish manufacturer.
- H. Painted Finish: Comply with Division 09 painting Sections.
- I. Finish System: Apply finish system, as indicated, on all ferrous metal surface exposed to view.
 - 1. Refer to Division 09 "Exterior Painting" Section for requirements.

2.10 ACCEPTABLE MANUFACTURER'S AND PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Anchors and Inserts: Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having anchors that are to be embedded in concrete as masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

- A. Manufacturer's Instructions: Comply with handrail and railing manufacturer's written instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance Work. Install handrail and railings in accordance with approved Shop Drawings.
- B. Fit exposed connections together to form tight, hairline joints.

- C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing handrails and railings. Set handrails and 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 have been 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 (5 mm in 3 m).
- D. Corrosion Protection: Coat concealed surfaces of aluminum alloys that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- E. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints.
- F. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.
- G. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base materials.
 - 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 that no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

3.3 HANDRAIL AND RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field. Cope of butt components to provide 100 percent contact, or use fittings designed for this purpose.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with a round flange of same metal as post, attached to post with set screws.
- D. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch (3-mm) buildup, sloped away from post.
- E. Anchor steel posts to steel with flanges, angle or floor type as required by conditions, welded to posts and bolted to metal supporting members.
- F. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel handrails and railings, weld flanges to posts and bolt to metal-supporting surfaces.
- G. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ANCHORING RAILING ENDS

- A. Anchor railing ends to concrete and masonry with flanges connected to railing ends and anchored to wall construction with anchors and bolts.

3.6 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to walls with wall brackets and end fittings. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets and wall return fittings to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

3.7 ADJUSTING AND CLEANING

- A. Adjustment: Restore finishes damaged during installation and construction period so that no evidence remains of corrective work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit; or provide new units.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.8 PROTECTION

- A. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer to ensure that the Work of this Section will be without damage or deterioration at Date of Substantial Completion. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057300

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 099600 "High-Performance Coatings" for painting requirements.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

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 anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at location to be determined.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Anchor rods.
4. Threaded rods.
5. Forged-steel hardware.

6. Shop primer.
7. Galvanized-steel primer.
8. Etching cleaner.
9. Galvanized repair paint.
10. Shrinkage-resistant grout.

B. Sustainable Design Submittals:

C. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members not to be shop primed.

D. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
- F. Survey of Existing Conditions.
- G. Source quality-control reports.
- H. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint Endorsement P3 or to SSPC-QP 3.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
- B. Connection Design Information:
 - 1. Fabricator's qualified professional engineer designs connections in accordance with ANSI/AISC 303.
 - a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
 - b. Use Load and Resistance Factor Design; data are given at factored-load level.

2.2 STRUCTURAL-STEEL MATERIALS

- A. Plate and Bar: ASTM A36/A36M.

- B. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.
- C. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.
- D. Steel Forgings: ASTM A668/S668M.
- E. Welding Electrodes: Comply with AWS requirements.

2.3 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A563 (ASTM A563M) hex and heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A36/A36M carbon steel.
 - 4. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
 - 5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C or Mechanically deposited zinc coating, ASTM B695, Class 50.
- B. Headed Anchor Rods: ASTM F1554, Grade 55, weldable, straight.
 - 1. Nuts: ASTM A563 (ASTM A563M) hex and heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A36/A36M carbon steel.
 - 3. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
 - 4. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C or Mechanically deposited zinc coating, ASTM B695, Class 50.

2.4 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.5 PRIMER

- A. Steel Primer:
 - 1. Comply with Section 099600 "High-Performance Coatings."

2.6 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

2.8 SHOP CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.9 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 - 1. SSPC-SP 6 (WAB)/NACE WAB-3.
- C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 2.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
 - 4. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

3.5 REPAIR

- A. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 051200

SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Architecturally exposed structural steel (AESS).
2. Section 051200 "Structural Steel Framing" requirements that also apply to AESS.

B. Related Requirements:

1. Section 099600 "High-Performance Coatings" for surface preparation and priming requirements.

1.2 DEFINITIONS

A. AESS: Architecturally exposed structural steel.

B. Category AESS 1: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 1 and may be designated AESS 1 or Category AESS 1 in the Contract Documents.

C. Category AESS 2: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 2 and is designated as AESS 2 or Category AESS 2 in the Contract Documents.

D. Category AESS 3: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 3 and is designated as AESS 3 or Category AESS 3 in the Contract Documents.

E. Category AESS 4: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 4 and is designated as AESS 4 or Category AESS 4 in the Contract Documents.

F. Category AESS C: Structural steel with custom characteristics that is categorized by ANSI/AISC 303, Section 10, as AESS C and is designated as AESS C or Category AESS C in the Contract Documents.

G. SEAC/RMSCA Guide Specification: SEAC/RMSCA's "Sample Specification, Section 05 02 13: Architecturally Exposed Structural Steel."

1.3 COORDINATION

A. Coordinate surface preparation requirements for shop-primed items.

B. 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.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at location to be determined.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Tension-control, high-strength, bolt-nut-washer assemblies.
2. Corrosion-resisting (weathering steel), tension-control, high-strength, bolt-nut-washer assemblies.
3. Filler.
4. Primer.
5. Galvanized-steel primer.
6. Etching cleaner.
7. Galvanized repair paint.

- B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS.

1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.
2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
3. Include embedment Drawings.
4. Indicate orientation of mill marks and HSS seams.
5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation and location of bolt heads.
7. Indicate exposed surfaces and edges and surface preparation being used.
8. Indicate special tolerances and erection requirements.
9. Indicate weep holes for HSS.
10. Indicate surface preparation, primer, and coating requirements, including systems specified in other Sections.

- C. Samples: Submit Samples to set quality standards for AESS.

1. Two steel HSS members with end of one with all around fillet weld to side of the other. Minimum size of smaller member HSS 4x4. Minimum face of larger member to receive perpendicular tube 6”.
2. Tapered round steel tube, minimum 8 inches (200 mm) in diameter, and 8” long to show vertical weld seams as smooth.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, and shop-painting applicator.

- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172) and is experienced in fabricating AESS similar to that indicated on this Project.
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program, is designated an AISC-Certified Erector, Category CSE, and is experienced in erecting AESS similar to that indicated on this Project.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P3 or SSPC-QP 3.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.
 - 1. Do not store AESS materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.9 FIELD CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round-head assemblies consisting of steel structural bolts with splined

ends; ASTM A563, Grade DH, (ASTMA563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

2.3 FILLER

- A. Polyester filler intended for use in repairing dents in automobile bodies.

2.4 PRIMER

- A. Steel Primer:

- 1. Comply with Section 099600 "High-Performance Coatings."

2.5 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.

- 1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.

- B. Category AESS 1:

- 1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
- 2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
- 3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
- 4. Make intermittent welds appear continuous, using filler or additional welding.
- 5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates unless noted otherwise on the Drawings.
- 6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
- 7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
- 8. Remove weld spatter, slivers, and similar surface discontinuities.
- 9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
- 10. Grind tack welds smooth unless incorporated into final welds.
- 11. Remove backing and runoff tabs, and grind welds smooth.

2.6 SHOP CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
- B. Surface Preparation: Clean nongalvanized surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 6 (WAB)/NACE WAB-3.
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 2.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments, showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

- A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.

1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
2. Grind tack welds smooth.
3. Remove backing and runoff tabs, and grind welds smooth.
4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
5. Remove erection bolts in Category AESS 1 AESS, fill holes with weld metal or filler, and grind or sand smooth to achieve surface quality approved by Architect.
6. Fill weld access holes in Category AESS 1 AESS with weld metal or filler and grind, or sand smooth to achieve surface quality as approved by Architect.
7. Conceal fabrication and erection markings from view in the completed structure.

B. In addition to ANSI/AISC 303, Section 10 requirements, comply with the following.

1. Erection of Category AESS 1:
 - a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
 - b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 - c. Remove weld spatter, slivers, and similar surface discontinuities.
 - d. Grind off butt and plug weld projections larger than 1/16 inch (1.6 mm).
 - e. Continuous welds are to be of uniform size and profile.
 - f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
 - g. Splice members only where indicated on Drawings.
 - h. No torch cutting or field fabrication is permitted.

3.4 FIELD CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

3.5 REPAIR

A. Touchup Painting:

1. Cleaning and touchup painting are specified in Section 099600 "High-Performance Coatings."

B. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to inspect AEES as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AEES in place to determine acceptability relating to aesthetic effect.

END OF SECTION 051213

SECTION 071113 - BITUMINOUS DAMPPROOFING

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 cold applied, cut-back and cold-applied, emulsified asphalt dampproofing applied to the following surfaces:
 - 1. Exterior, below-grade surfaces of concrete and masonry foundation walls.
 - 2. Back side of concrete and masonry retaining walls, below grade.
 - 3. Exterior face of concrete and masonry indicated to receive stone veneer assemblies and dimension stone cladding.

1.3 SUBMITTALS

- A. Section Cross Reference: Refer to Division 01 Submittals Section for general requirements.
- B. Product Data: For each type of product indicated, for information only. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.
- C. Material Certificates: For each product, signed by manufacturers.
 - 1. Certification by dampproofing manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's).
- D. Installer Certification: Submit written documentation certifying that Installer complies with requirements of "Installer Qualifications" below.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer Qualifications: Engage a firm specializing in bituminous dampproofing installations. Installer shall have successfully completed at least ten (10) projects of the same materials, design and of similar size and scope to that indicated for this Project and with a record of successful in-service performance.

- B. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Substrate: Proceed with dampproofing only after substrate construction and penetrating work have been completed.

PART 2 - PRODUCTS

2.1 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Degussa Building Systems; Sonneborn Brand Products.
 - 2. Meadows, W. R., Inc.
 - 3. Tamms Industries, Inc.
- C. Trowel Coats: ASTM D 4586, Type I, Class 1, fibered.
- D. Brush and Spray Coats: ASTM D 4479, Type I, fibered.
- E. VOC Content: 250 g/L or less.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Degussa Building Systems; Sonneborn Brand Products.
 - 2. Meadows, W. R., Inc.
 - 3. Tamms Industries, Inc.
- C. Trowel Coats: ASTM D 1227, Type II, Class 1.
- D. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

- E. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
- F. VOC Content: Zero.

2.3 PROTECTION COURSE

- A. Protection Course, Asphalt-Board Type: ASTM D 6506, premolded, 1/8-inch- (3-mm-) thick, multi-ply, semirigid board consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt, and faced on 1 side with polyethylene film.
- B. Protection Course, Roll-Roofing Type: Smooth-surfaced roll roofing complying with ASTM D 6380, Class S, Type III.

2.4 MISCELLANEOUS MATERIALS

- A. Cut-Back Asphalt Primer: ASTM D 41.
- B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.
- C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
 - 1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.
 2. Allow each coat of dampproofing to cure 12 hours before applying subsequent coats.
 3. Allow 36 hours drying time prior to backfilling.
- B. Apply dampproofing to footings and foundation walls where opposite side of wall faces building interior whether indicated or not.
1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches (150 mm) over outside face of footing.
 2. Extend 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

- A. On Concrete Foundations Walls: Apply 2 brush or spray coats at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, or 1 trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).
- B. On Unparged Masonry Foundation Walls: Apply primer and 2 brush or spray coats at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, or primer and 1 trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).
- C. On Unexposed Face of Concrete Retaining Walls: Apply 1 brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).
- D. On Unexposed Face of Masonry Retaining Walls: Apply primer and 1 brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).
- E. On Concrete Backup for Stone Veneer Assemblies: Apply 1 brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).
- F. On Masonry Backup for Stone Veneer Assemblies: Apply primer and 1 brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

3.5 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. On Concrete Foundations and Walls: Apply 2 brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, 1 fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m), or 1 trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).
- B. On Unparged Masonry Foundation Walls: Apply primer and 2 brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second

coat, primer and 1 fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m), or primer and 1 trowel coat at not less than 5 gal./100 sq. ft. (2 L/sq. m).

- C. On Unexposed Face of Concrete Retaining Walls: Apply 1 brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).
- D. On Unexposed Face of Masonry Retaining Walls: Apply primer and 1 brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).
- E. On Concrete Backup for Stone Veneer Assemblies: Apply 1 brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).
- F. On Masonry Backup for Stone Veneer Assemblies: Apply primer and 1 brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

3.6 INSTALLATION OF PROTECTION COURSE

- A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing material manufacturer's written recommendations for attaching protection course.
 - 1. Support protection course with spot application of adhesive of type recommended by protection board manufacturer over cured coating.
 - 2. Install protection course on same day of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.7 CLEANING

- A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 071113

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

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:
 - 1. Single-component polyurethane waterproofing.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide waterproofing membrane that prevents the passage of water.

1.4 SUBMITTALS

- A. Section Cross Reference: Refer to Division 01 Submittals Section for general requirements.
- B. Product Data: For each type of product indicated, for information only. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- C. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
 - 1. Include setting drawings showing layout, sizes, sections, and profiles.
- D. Samples: For the following products:
 - 1. Flashing sheet, 12-by-12-inch (300-by-300-mm) square of flashing sheet.
 - 2. Insulation, 12-by-12-inch (300-by-300-mm) square of insulation.
 - 3. Drainage panel, 4 by 4 inches (100 by 100 mm).
- E. Installer Certificates: Written documentation signed by manufacturers certifying that installers comply with requirements.
- F. Qualification Data: For Installer.

- G. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency indicating and interpreting test results of waterproofing for compliance with requirements.
- H. Warranty: Sample of special warranty. Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.
- B. Source Limitations: Obtain waterproofing materials from single source from single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Project Management and Coordination Section.
 - 1. Review waterproofing requirements including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
 - 1. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

- B. Maintain adequate ventilation during application and through complete curing of waterproofing materials.

1.8 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form, signed by waterproofing manufacturer, in which waterproofing manufacturer and Installer agree to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 - 1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/16 inch (1.6 mm) in width.
 - 2. Warranty Period: Five (5) years from date of Substantial Completion.
- B. Special Installer's Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of five (5) years.
 - 1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 SOURCE QUALITY CONTROL

- A. General Compatibility: Provide products which are recommended by manufacturer to be fully compatible with indicated substrates, including modification by bituminous additives (asphalt or coat tar as needed) and similar proven compounding provisions.

2.2 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

- A. Single-Component, Modified Polyurethane Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements. (Retaining walls and planters).
 - 1. Products: Subject to compliance with requirements:
 - a. Anti-Hydro International, Inc.; A-H Seamless Membrane.
 - b. Degussa Building Systems; HLM 5000.
 - c. Tremco Incorporated; Tremproof 60.
- B. Single-Component, Modified Polyurethane Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements. (Water Features and Fountains).
 - 1. Products: Subject to compliance with requirements:
 - a. Tremco Incorporated; Vulkem 450/320
 - b. C.I.M. Industries, Inc.: CIM 1000.
 - c. Anti Hydro International, Inc.; Coal Tar Epoxy 210.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.
- B. Primer: Manufacturer's standard, factory-formulated polyurethane or epoxy primer.
- C. Sheet Flashing: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.
 - 1. Adhesive: Manufacturer's recommended contact adhesive.
- D. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- E. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing, complying with ASTM C 920 Type M, Class 25; Grade NS for sloping and vertical applications or Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions and for compatibility with waterproofing.
 - 1. Backer Rod: Closed-cell polyethylene foam.

2.4 PROTECTION COURSE

- A. Protection Course: Semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
 - 1. Thickness: 1/4 inch (6 mm), nominal.
 - 2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection course.

2.5 MOLDED-SHEET DRAINAGE PANELS

- A. Molded-Sheet Drainage Panel: Comply with Division 33 Section "Subdrainage."
- B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per ft. (112 to 188 L/min. per m).
- C. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a horizontal flow rate not less than 2.8 gpm per ft. (35 L/min. per m).
- D. Molded-Sheet Drainage Panel: Prefabricated, composite drainage panels, manufactured with a permeable geotextile facing laminated to a molded-plastic-sheet drainage core.

1. Drainage Core: Three-dimensional, nonbiodegradable, molded-plastic-sheet material designed to effectively drain water under backfill pressure; complying with the following properties determined according to tests indicated.
 - a. Compressive Strength: 15,000 lbf/sq. ft. (718 kPa) minimum; ASTM D 1621.
 - b. Flow Rate: 100 gpm per ft. (1242 L/min. per m) , minimum, at hydraulic gradient of [1.0] and compressive stress of 25 psi (172 kPa) ASTM D 4716.

2.6 INSULATION

- A. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, square edged; of type, density, and compressive strength indicated below.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Chemical Company (The).
 - b. Owens Corning.
 2. Type V, 3-lb/cu. ft. (48-kg/cu. M) minimum density and 100-psi (690-kPa) minimum compressive strength.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions under which waterproofing systems will be applied, with Installer present, for compliance with requirements and other conditions affecting performance.
 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

- D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
 - 1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.
- E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.3 PREPARATION AT TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C 898 and manufacturer's written instructions.
- B. Prime substrate unless otherwise instructed by waterproofing manufacturer.
- C. Apply a double thickness of waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
 - 1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 898 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.
 - 1. Comply with ASTM C 1193 for joint-sealant installation.
 - 2. Apply bond breaker between sealant and preparation strip.
 - 3. Prime substrate and apply a single thickness of preparation strip extending a minimum of 3 inches (75 mm) along each side of joint. Apply a double thickness of waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.
- B. Install sheet flashing and bond to deck and wall substrates where indicated or required according to waterproofing manufacturer's written instructions.
 - 1. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C 898.

3.5 WATERPROOFING APPLICATION

- A. Apply waterproofing according to ASTM C 898 and manufacturer's written instructions.

- B. Start installing waterproofing in presence of manufacturer's technical representative.
- C. Apply primer over prepared substrate.
- D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
 - 1. Apply one or more coats of waterproofing according to manufacturer's recommendations and written instructions for multiple coats (applications) to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils (1.5 mm) and a minimum dry film thickness of 50 mils (1.3 mm) at any point.
 - 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
 - 3. Verify wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).
- E. Install protection course with butted joints over nominally cured membrane no later than recommended by manufacturer and before starting subsequent construction operations.
 - 1. Board insulation may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer.

3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or mechanical fasteners that do not penetrate waterproofing. Lap edges and ends of geotextile fabric to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. For vertical applications, install protection course before installing drainage panels.

3.7 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use type of adhesive recommended in writing by insulation manufacturer.
- C. On horizontal surfaces, place insulation units unadhered according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.8 FIELD QUALITY CONTROL

- A. Engage a full time site representative qualified by the waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, and application of the membrane, flashings, protection, and drainage components; and to furnish daily reports to Landscape Architect.

- B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - 1. Flood to an average depth of 2-1/2 inches (64 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of sheet flashings.
 - 2. Flood each area for 24 hours.
 - 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- C. Engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

3.9 CURING, PROTECTION, AND CLEANING

- A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.
 - 1. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed board insulation from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Immediately after installation, provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071416

SECTION 079200 - 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. Silicone joint sealants.
- 2. Urethane joint sealants.

- B. Exterior joints in horizontal traffic surfaces as indicated below:

- 1. Expansion joints in brick pavers set with mortar.
- 2. Control, expansion and isolation joints in cast-in-place concrete slabs for paving.
- 3. Joints in architectural precast concrete paving units.
- 4. Joints between different materials listed above and between curbs, building facades and existing structures.

- C. Exterior joints in vertical surfaces as indicated below:

- 1. Control and expansion joints in cast-in-place concrete.
- 2. Joints between architectural precast concrete units.
- 3. Control and expansion joints in unit masonry.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

- 1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- 2. Submit not fewer than three (3) pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
- 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
- 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
- 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for

adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.4 SUBMITTALS

- A. Section Cross Reference: Refer to Division 01 Submittals Section for general requirements.
- B. Product Data: Submit, for information only, manufacturer's product data for each joint-sealant product indicated, including instructions for joint preparation and joint sealant application.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants. Install joint sealants sample in project mock-up for approval by Landscape Architect.
- E. Qualification Data: Submit written documentation certifying that installer complies with requirements of "Installer Qualifications" below.
- F. Product Certificates: For each kind of joint sealant and accessory, from manufacturer of joint sealants certifying that their products furnished comply with requirements and are suitable for the use indicated.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- H. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- I. Warranties: Sample of special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Industry Reference Standards: Refer to Division 01 References Section.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project. Engage a firm specializing in joint sealant applications. Installer shall have successfully completed at least ten (10) projects of the same material, design, and of similar size and scope to that indicated for this Project with a record of successful in-service performance.
 - 1. Firm Experience Period: Seven years minimum.

- C. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- D. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- E. Field Constructed Mockups: Prior to installation of joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution:
 - 1. Joints in field constructed mock-ups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specific by reference to this Section.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: 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.
 - 2. When joint substrates are wet.
 - 3. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Joint Substrate Conditions: Do not proceed with installation of joint sealants where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
 - 5. Sequence joint sealant installation to occur after water repellent installation.

1.7 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original unopened containers with labels indicating manufacturer; product name and designation; color, expiration date, pot life, curing time and mixing instructions for multi-component materials.

- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, conaminants, or other causes.

1.9 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Twenty (20) years from date of Substantial Completion.
- D. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, 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.
- B. Colors of Exposed Joint Sealants: As selected by Landscape Architect from manufacturer's full range.

2.2 PRODUCTS AND MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one (1) of the products indicated for each type in the sealant schedules at the end of Part 3.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants Standards: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemical curing sealant in the Elastomeric Joint Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class and uses.
- B. Additional Movement Capability: Where additional movement capability is specified in Elastomeric Joint Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.
- C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Continuous-Immersion-Test-Response Characteristics: Where elastomeric sealants will be immersed continuously in water, provide products that have undergone testing according to ASTM C 1247, including six (6) week immersion period and additional immersion periods specified below, and have not failed in adhesion or cohesion when tested with substrates indicated for Project.
 - 1. Two (2) additional four (4) week immersion periods.

2.4 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
- B. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

2.5 URETHANE JOINT SEALANTS

- A. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.
- B. Immersible Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Uses T and I.

2.6 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or Type O (open-cell material); not suitable for horizontal surfaces; and of size and density to control sealant depths; prevent bottom-side adhesion of sealant and otherwise contribute to producing optimum sealant performance.
- C. Backer Strips for Cold-Applied Sealants: ASTM D 5249, Type 2, closed cell polyethylene; of thickness and width required to control sealant depths, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
 - 1. Available Products: Subject to compliance with requirements, products may be incorporated in the Work includes, but are not limited to, the following:
 - a. Acceptable Manufacturer and Products:
 - 1) Manufacturer: W.R. Meadows, Inc.
 - a) Product: Sealtight Deck-O-Foam.
 - 2) Manufacturer: Sonneborn; ChemRex, Inc.
 - a) Product: Sonolastic Expansion-Joint Filler.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 JOINT FILLER MATERIALS

- A. General: Provide joint fillers of thicknesses and widths indicated.
- B. Bituminous Fiber Joint Filler: Preformed strips of composition below, complying with ASTM D 1751:
 - 1. Asphalt saturated fiberboard.
- C. Asphalt Joint Filler: ASTM D 994, preformed strips, water proof and self sealing.
- D. Plastic Joint Filler Caps: Two-piece preformed plastic cap of thickness and width required to provide reservoir for joint sealant, and prevent bottom-side adhesion of sealant.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work includes, but are not limited to, the following:
 - a. Acceptable Manufacturer and Products:

- 1) Manufacturer: W.R. Meadows, Inc.
 - a) Product: Sealtight Snap-Cap.
- 2) Manufacturer: Bo Metals, Inc.
 - a) Product: Expansion Board Caps.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated 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: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

- a. Concrete.
 - b. Masonry.
3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support 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 sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet 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.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below 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 sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other

requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. 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 so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Multi-Component Nonsag Urethane Sealant ES-1: Where joint sealants of this type are indicated, provide products complying with the following:
 - 1. Products: Provide one of the following:
 - a. Manufacturer: Tremco, Inc.
 - 1) Product: Vulkem 116 (cont. water immersion).
 - 2) Product: Vulkem THC-901.
 - b. Manufacturer: Pecora Corp.
 - 1) Product: Dynatred
 - 2) Product: Dynaflex (heavy high heal exposure)
 - c. Manufacturer: BASF Construction Chemicals
 - 1) Product: Sonneborn Sonolastic SL-2
 - 2. Type and Grade: M (Multi component) and NS (nonsag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: T (traffic).
 - 5. Uses Related to Joint Substrates: M, a, and as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Brick, granite, limestone and wood.
 - 6. Applications: Concrete pavement, sidewalks, curb, curb and gutter, brick paving and stone paving.

- B. Low-Modulus Nonacid-Curing Silicone Sealant ES-2: Where joint sealants of this type are indicated, provide products complying with the following:
1. Acceptable Manufacturers and Products:
 - a. Manufacturer: Dow Corning Corp.
 - 1) Product: Dow Corning 790.
 - b. Manufacturer: Pecora Corp.
 - 1) Product: Pecora 890, NST.
 - c. Manufacturer: GE Silicones/Momentive Performance Materials
 - 1) Product: SilPruf LM SCS 2700.
 - d. Manufacturer: Tremco, Inc.
 - 1) Product: Spectrem I.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 25.
 4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
 5. Use Related to Exposure: NT (nontraffic).
 6. Uses Related to Joint Substrates: M, G, A, and as applicable to joint substrates indicated, O.
 - a. Use O Joints Substrates: Galvanized steel, brick, granite, limestone, marble, ceramic tile, and wood.
 7. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
 8. Applications: Stone cladding, cast-in-place architectural concrete and precast architectural concrete.
- C. High-Modulus Neutral-Curing Silicone Sealant ES-3: Where joint sealants of this type are indicated, provide products complying with the following:
1. Products: Provide one of the following:
 - a. Manufacturer: Dow Corning, Corp.
 - 1) Product: Dow Corning 795.
 - b. Manufacturer: Tremco, Inc.
 - 1) Product: Spectrem 2.
 - c. Manufacturer: GE Silicones/Momentive Performance Materials

- 1) Product: SilPurf NB SCS 9000.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Galvanized steel.
6. Applications: Stone Cladding Kerfs.

END OF SECTION 079200

SECTION 099600 - HIGH-PERFORMANCE COATINGS

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 surface preparation and the application of high-performance coating systems on the following substrates:
 - 1. Exterior Substrates:
 - a. Steel.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing", Section 051213 "Architecturally Exposed Structural Steel Framing" for shop priming of structural steel with primers specified in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 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. Coatings: 5 percent, but not less than 1 gallon of each material and color applied.

1.5 QUALITY ASSURANCE

- A. Apply mock-ups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Landscape Architect will select one surface to represent surfaces and conditions for application of each coating system.
 2. Final approval of color selections will be based on mock-ups.
 - a. If preliminary color selections are not approved, apply additional colors selected by Landscape Architect at no added cost to Owner.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents unless Landscape Architect specifically approves such deviations in writing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS MATERIALS

- A. Except as otherwise specified herein or as specifically approved by the Landscape Architect, all materials shall be products of the following manufacturer, subject, however, in compliance with specification requirement:
- B. 1) Tnemec Company, Inc. –770-242-9605. BASIS OF DESIGN.

C. Other acceptable manufacturers.

The Sherwin Williams Company

Corotech Coatings; Benjamin Moore and Co.

D. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Contractor shall also secure a written statement from the painting manufacturer attesting to the compatibility of the proposed paint systems with the existing paint described hereinafter.
4. Products shall be of same manufacturer for each coat in a coating system.

E. Colors: As selected by Landscape Architect from manufacturer's full range

2.2 MATERIALS SELECTION, COLORS AND LABELING

- A. The contractor shall furnish information to the Landscape Architect by way of shop drawing submittal for the materials proposed to be used. The information shall include complete product specification sheets, manufacturer's instructions, and color selection guides.
- B. The Landscape Architect will return the color schedule and return the same to the Contractor along with the reviewed shop drawings.
- C. All materials shall be delivered to the site in manufacturer's sealed containers. The manufacturer shall label each container. Labels shall give the manufacturer's name, brand, type of paint, color of paint, and instructions for reducing. Thinning shall be done only in accordance with direction of the manufacturer and exclusively with the types of reducer recommended. Mixing or job tinting may be done when approved by the Landscape Architect.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
 1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials

from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

2.4 SCHEDULE OF NEW PAINTING SYSTEMS

- A. The following schedule contains paint system specifications for Tnemec Company, Inc.
- B. Products specified are manufactured by Tnemec Company, Inc., North Kansas City, Missouri, 1-800-863-6321 and are specified as a standard of quality.
- C. Equivalent materials of other manufacturers may be substituted only by approval of the Landscape Architect. Request for substitution shall include manufacturer's literature for each product giving the name, generic type, descriptive information, and solids by volume; recommended dry film thicknesses and a list of five projects where each product has been used and rendered satisfactory service.
- D. No request for substitution in the generic type of coating specified. Manufacturer's certified test reports showing the performance of the specified products as outlined on the manufacturer's product data sheets, shall be submitted.
- E. Bidders desiring to use coatings, other than those specified, shall submit those with their proposal based on the specified materials, together with the information required in Paragraph 2.4B above, and indicate the sum which will be added to or deducted from the base bid should alternate materials be accepted.
- F. Products for each specified function and system shall be of a single manufacturer.
- G. Coating Systems

2.5 HIGH-PERFORMANCE COATING SYSTEMS FOR EXTERIOR STEEL

- A. Exterior: Zinc Rich/Epoxy/Acrylic Polyurethane
- B. Surface Preparation: (Shop) Spot SSPC-SP 6 Commercial Blast. Field Touch up: SSPC-SP11 Power Tool Clean to Bare Metal
- C. Shop Prime Coat: Series 90G1K applied at 2.5-3.5 mils DFT
- D. Field Touch Up: Series 394 applied at 2.5 to 3.5 mils DFT
- E. Field Second Coat: Series 66 (Color) applied at 2.0 to 3.0 mils DFT
- F. Field Finish Series 1095 (semi-gloss) applied at 2.0 to 3.0 mils DFT
- G. Total DFT: 6.5-9.5 mils DFT

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 the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and coating systems indicated.
 - 1. Surfaces shall be clean, dry and adequately protected from dampness.
 - 2. Surfaces shall be free of any material, which will adversely affect appearance of painting and coating.
 - 3. Cleanliness shall be checked by wiping the prepared steel surface with a white cloth dampened with manufacturer's thinner for the particular paint system. If a dark spot appears on the rag from light wiping, the contractor shall take steps to clean the surface more thoroughly before applying paint.
 - 4. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- B. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
 - 2. All materials shall be applied in accordance with manufacturer's directions and any thinning required shall be done in a manner and exclusively with the type of reducer recommended.
 - 3. All materials shall be applied under adequate illumination.
 - 4. Materials shall be thoroughly mixed and kept at a uniform consistency during application. Structurally observe the pot life limitations.

- C. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - 1. SSPC-SP 6/NACE No. 3.
 - 2. SSPC-SP 10/NACE No. 2.
- D. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations.
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Finished work shall be uniform and of the approved color. It shall completely cover, be smooth and free of runs, sags, wrinkles, shiners, streaks and brush marks.
 - 3. Make edges of paint adjoining other materials or colors sharp and clean without overlapping.
 - 4. Brush or roll an additional coat of primer over primed over primed weld seams.
 - 5. No painting or finishing shall be done under conditions which are unsuitable for the production of good results.
 - 6. The surfaces to be painted shall be at least 5 F. above the dew point. Apply all paint consistent with temperatures exterior paint in damp, rainy weather. Do no apply finishes in spaces where dust is being generated.
- B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 - 1. Contractor shall touch up and restore coated surfaces damaged by testing. Total minimum dry film thickness of paint films specified herein will be measured with an Elcometer or similar instrument to determine acceptability. Special attention shall be given to weld seams.

2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 TOUCH UP AND REPAIR

- A. At completion, all painted surfaces and coatings shall be inspected. All damaged spots, whether due to defective materials or workmanship or defects of surfaces covered shall be touched up and the finish restored. Additional coats of paint and coatings required to cover all spots or discoloration of every sort shall be applied at no additional costs to the Owner.
- B. The contractor shall furnish to the Owner at least one (1) extra gallon of finish paint specified above for exterior paint for touch-up repairs due to vandalism.

3.7 FIRST ANNIVERSARY INSPECTION

- A. The Owner shall establish a time period for inspection of paint systems within the contract guarantee period.

END OF SECTION 099600

SECTION 129300 - SITE FURNISHINGS

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. Seating
2. Tables
3. Bicycle racks
4. Trash receptacles
5. Ash receptacles
6. Planter.
7. Bollards
8. Benches
9. Tree grates and frames
10. Drinking fountains

1.3 SUBMITTALS

- A. Section Cross Reference: Refer to Division 01 Submittals Section for general requirements.
- B. Product Data: For each type of product indicated, for information. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, field-assembly requirements, and installation details.
- C. Shop Drawings
 1. Submit complete shop drawings for all pre-fabricated items and the installation of such items. Indicate member dimensions, cross section, finishes and connection details. Include plans, elevations, sections, and large scale details.
 - a. Indicate required anchorage and accessory items.
 - b. Provide location and details of anchorage devices that are to be embedded in other construction. Furnish templates if required for accurate placement.
- D. Samples for Initial Selection: For units with factory-applied finishes.
- E. Samples for Verification: For each type of exposed finish, not less than 6-inch- (152-mm-) long linear components and 4-inch- (102-mm-) square sheet components.

1. Include full-size Samples of [bench] [table] [bicycle rack] [trash receptacle] [ash receptacle] <Insert product>.
- F. Material Certificates: For site and street furnishings, signed by manufacturers.
1. Wood Preservative Treatment: Include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
 2. Sustainably Harvested Wood: Include certification by manufacturer and from sources that participate in sustained yield programs.
 3. Recycled plastic.
- G. LEED Submittals:
1. Product Data for Credit MR 4.1[and Credit MR 4.2]: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Certificates for [Credit MR 6] [Credit MR 7]: Chain-of-custody certificates indicating that wood components of site furnishings comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
- H. Maintenance Data: For site and street furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Products: Subject to compliance with requirements, provide the following:
- B. Basis of Design Product: Subject to compliance with requirements, provide the following or comparable product.
- C. Benches: Provide manufacturer's prefabricated bench.
 1. Acceptable Manufacturer and Product: Bench Type 'A' and 'A-1'.
 - a. Manufacturer: Landscape Forms
 - 1) Product: Type 'A' – Hyde Park Bench; 59 inches; Ipe; Grotto
 - 2) Product: Type 'A-1' – Hyde Park Bench' 75 inches; Ipe: Grotto
 2. Acceptable Manufacturer and Product: Bench Type 'B'.
 - a. Manufacturer: Landscape Forms
 - 1) Product: Presidio Collection: Refer to drawings for groupings.

3. Acceptable Manufacturer and Product: Bench Type ‘C’.
 - a. Manufacturer: Landscape Forms
 - 1) Product: Plainwell (without arm); Ipe; Grotto.
 4. Acceptable Manufacturer and Product: Bench Type ‘D’ and ‘D-1’.
 - a. Manufacturer: Country Casual
 - 1) Product: Type ‘D’ – Colby Backless Bench – No. 4315.
 - 2) Product: Type ‘D-1’ – Colby Backless Bench – No. 4314.
 5. Acceptable Manufacturer and Product: Bench Type ‘E’.
 - a. Manufacturer: Sitecraft
 - 1) Product: Style YN; Ipe.
 6. Acceptable Manufacturer and Product: Bench Type ‘F’.
 - a. Manufacturer: Country Casual
 - 1) Product: Custom Glenham Curved Seat – No. 6404; Armless and Backless
- D. Litter Receptacles: Provide manufacturer’s prefabricated litter receptacle.
1. Acceptable Manufacturer and Product: Trash Receptacle Type ‘A’
 - a. Manufacturer: Landscape Forms
 - 1) Product: Napoleon Ash Urn; embedded; with litter receptacle; keyed lock; Grotto
 2. Acceptable Manufacturer and Product: Trash Receptacle Type ‘B’.
 - a. Manufacturer: Landscape Forms
 - 1) Product: Presidio Collection: side opening; Ash Urn; keyed lock; Grotto.
 3. Acceptable Manufacturer and Product: Trash Receptacle ‘C’.
 - a. Manufacturer: Landscape Forms
 - 1) Product: Plainwell; Ipe; Grotto.
 4. Acceptable Manufacturer and Product: Bench Type ‘D’.
 - a. Manufacturer: Gardenside, Ltd.
 - 1) Product: Litter Container Covered Top and Estate Planter - No. 5024 and No. 5020.

5. Acceptable Manufacturer and Product: Bench Type 'E'.

a. Manufacturer: Landscape Forms

- 1) Product: Gretchen Litter Receptacle, Side Openings; Ipe; Lid Grotto.

E. Tables: Provide manufacturer's prefabricated tables.

1. Acceptable Manufacturer and Product:

a. Manufacturer: Landscape Forms

- 1) Product: Catena; CT 4002-36-XQFM; Grotto

F. Chairs: Provide manufacturer's prefabricated chairs.

1. Acceptable Manufacturer and Product:

a. Manufacturer: Landscape Forms

- 1) Product: Travis; TR 3001-BA-20; Grotto.

G. Canopies: Provide manufacturer's prefabricated canopies.

1. Acceptable Manufacturer and Product:

a. Manufacturer: Landscape Forms

- 1) Product: Kaleidoscope; Refer to Drawings for groupings; Grotto; Refer to lighting drawings for canopy light fixture.

H. Drinking Fountains: Provide manufacturer's prefabricated drinking fountain.

1. Acceptable Manufacturer and Product:

a. Manufacturer: Haws.

- 1) Product: Barrier Free Pedestal Mounted Model 3376FR.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:

1. Rolled or Cold-Finished Bars, Rods, and Wire: **ASTM B 211** (ASTM B 211M).
2. Extruded Bars, Rods, Wire, Profiles, and Tubes: **ASTM B 221** (ASTM B 221M).
3. Structural Pipe and Tube: ASTM B 429.
4. Sheet and Plate: **ASTM B 209** (ASTM B 209M).
5. Castings: ASTM B 26/B 26M.

B. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
 2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53, or electric-resistance-welded pipe complying with ASTM A 135.
 3. Tubing: Cold-formed steel tubing complying with ASTM A 500.
 4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500; zinc coated internally and externally.
 5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.
 6. Perforated Metal: From steel sheet not less than [**0.0747-inch (1.9-mm)**] [**0.0897-inch (2.3-mm)**] [**0.1196-inch (3.0-mm)**] <Insert dimension> nominal thickness; manufacturer's standard perforation pattern.
 7. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F 1267.
 8. Malleable-Iron Castings: ASTM A 47/A 47M, grade as recommended by fabricator for type of use intended.
 9. Gray-Iron Castings: ASTM A 48/A 48M, Class 200.
- C. Stainless Steel: Free of surface blemishes and complying with the following:
1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
 2. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.
 3. Tubing: ASTM A 554.
- D. Wood: Surfaced smooth on four sides with eased edges; kiln dried, free of knots, solid stock of species indicated.
1. Wood Species: [**Manufacturer's standard.**]
 - a. Douglas Fir: Clear Grade, vertical grain.
 - 1) Finish: Manufacturer's standard [**stain and**] [**transparent sealer**] [**transparent wood preservative treatment and sealer**].
 - b. Pine: Southern pine; No. 2 or better[; **preservative treated, kiln dried after treatment**].
 - 1) Finish: Manufacturer's standard [**stain and**] [**transparent sealer**] [**transparent wood preservative treatment and sealer**].
 - c. [**Eastern White**] [**Red**] [**Yellow**] Cedar: Select Grade or better.
 - d. Redwood: [**Clear all heart**] [**Construction heart or better**], free-of-heart center; **RIS**.
 - e. Teak (Tectona Grandis): Clear Grade.[**Provide wood obtained from sources that participate in a well-managed forest and chain-of-custody program certified by an independent agency accredited by FSC.**]
 - f. Mahogany (Swietenia Spp): Clear grade.
 - g. Ipe (Tabebuia Spp): Clear grade.
 - h. Jarrah (Eucalyptus Marginata): Select grade or better.
 - i. Jatoba (Hymenaea Courbaril): Clear grade.
 - j. Pau Lope: [**insert treatment or finish**]

- k. **Purpleheart (Peltogyne Spp): Clear grade.**
 - l. **Finish: Manufacturer's standard [stain] [and] [transparent sealer] [transparent wood preservative treatment and sealer] <Insert treatment or finish>.**
- E. Fiberglass: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and manufacturer's standard finish.
- F. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.
- 1. Polyethylene: Fabricated from virgin plastic HDPE resin.
 - 2. Recycled Polyethylene: Fabricated from not less than **[96 percent recycled, purified, fractional-melt plastic resin]** <Insert percentage of recycled plastic and resin characteristics> with not less than **96 percent recycled, purified, fractional-melt plastic resin with not less than 90 percent recycled postconsumer waste by weight HDPE.**
- G. Anchors, Fasteners, Fittings, and Hardware: **[Stainless steel] [Brass] [Galvanized steel] [Zinc-plated steel] [Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials]**; commercial quality[, **tamperproof, vandal and theft resistant**][, **concealed, recessed, and capped or plugged**].
- 1. Angle Anchors: For inconspicuously bolting legs of site furnishings to **[on] [below]**-grade substrate; **[one per leg] [extent as indicated]** <Insert extent>.
 - 2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate; **[two per unit] [extent as indicated on Drawings]** <Insert extent>.
- H. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107; recommended in writing by manufacturer, for exterior applications.
- I. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.
- J. Galvanizing: Where indicated for steel and iron 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.
- K. **Ferrous Metal for Tree Grates and Frames: ASTM A 48, Class 35 or better, gray-iron castings and ASTM A 36 steel angle frames of shape, pattern, and size indicated.**
- L. **Aluminum for Tree Grates and Frames: ASTM B 26, aluminum casting of shape, pattern, and size indicated.**

2.3 WOOD PRESERVATIVE – TREATED MATERIALS

- A. Wood Preservative Treatment: Include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards of jurisdictions having authority.

2.4 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. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWP A M4 to cut surfaces.
- E. 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.
- F. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.
- G. Steel and Iron Components: Galvanized, galvanized or color coated, or color coated. Bare metal steel or iron components are not permitted.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of **abutting or adjacent** components are acceptable if they are within **one-half of the range** of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.7 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.
- B. 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.

2.8 IRON FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.9 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run directional finishes with long dimension of each piece.
 - 2. Directional Satin Finish: No 4.
 - 3. Dull Satin Finish: No. 6.

2.10 SHOP APPLIED PROTECTION

- A. Before shipping or exposing to outdoor conditions, individually wrap each item with manufacturer's standard, durable weather-resistive covering.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, 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. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site and street furnishings where required.

- B. Unless otherwise indicated, install site **and street** furnishings after landscaping and paving have been completed.
- C. Install site **and street** furnishings level, plumb, true, and [**securely anchored**] [**positioned**] at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site **and street** furnishings and **3/4 inch (19 mm)** larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with [**nonshrink, nonmetallic grout**] [**or**] [**anchoring cement**], mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.
- F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been 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, with top smoothed and shaped to shed water.

3.3 TREE GRATES

- A. Install steel angle frame, in concrete flush and leveled with surrounding pavement surface, maintain flush and leveled at all times.

END OF SECTION 129300

SECTION 131200 - FOUNTAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Supply and installation of fountain mechanical and electrical equipment in accordance with the Contract Documents. Furnish all labor, materials, equipment, and services as required for a complete working fountain installation, as detailed in the project drawings and specifications.

1.02 RELATED WORK

1.03 REFERENCES

- A. This installation shall comply with all applicable provisions of the latest edition of the following codes:
 - NEC National Electrical Code.
 - BOCA National Building Code.
 - UPC Uniform Plumbing Code.
- B. Materials furnished hereunder shall comply with the latest edition of applicable standard specifications published by the following organizations:
 - ASTM - American Society for Testing and Materials.
 - ANSI - American National Standards Institute.
 - ASME - American Society of Mechanical Engineers.
 - ASSE - American Society of Sanitary Engineering.
 - AWWA - American Water Works Association.
 - CS - Commercial Standards.
 - NEMA - National Electrical Manufacturers Association.
 - NSF - National Sanitation Foundation.

1.04 SYSTEM DESCRIPTION

- A. Prime contractor shall furnish all labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services as required to make a complete working fountain installation, as shown on the drawings or described in these specifications.
- B. Work included:
 - 1. Fountain display system including pumps, valves, piping and specialties.
 - 2. Fountain filtration system including filter, media, valves, piping and specialties.
 - 3. Fountain water treatment system and related accessories.
 - 4. Fountain plumbing and electrical services including water, sewer and power supply to designated points of connection with site utilities.

5. All special tools for proper operation and maintenance of the equipment provided under this section.
- C. Water effects shall be as follows:
1. The Rosa Parks Square Fountain is an exterior memorial water wall fountain with a weir edge that is approximately 250'-0" in width and approximately 8'-9" in height. At the top of the fountain is a formed concrete trough. Water is introduced to the upper trough and evenly overflows its edge and then runs down the face of waterwall into a lower basin. Water in the lower basin is returned to an equipment vault for filtration and recirculation. There are (7) freestanding LED light fixture with RGBW diodes included in the lower basin to shine upward on the fountain wall and signage. Lights can be set on any individual color, or white. The pump equipment vault is in a plaza area and is pre-assembled with a tile set hatch, 7.5 HP fountain pump, sand filter, erosion style chemical feeder, valve assemblies, sump pump, vent fan, fill manifold, and a UL electrical control panel in NEMA enclosure with motor starters, breakers, light power supplies, lighting interface controller, digital timeclock, and main disconnect switch.

1.05 DRAWINGS

- A. Drawings for this work consist of a set of plans, detail drawings and diagrams. Other drawings may be added by the Architect during the period of construction, as required for clarification of proper installation of equipment.
- B. The drawings accompanying these specifications are to be considered as important and integral parts of same, and anything omitted from one and embodied in the other is to be considered as essential to the requirements of the contract and must be furnished and installed by the Contractor.
- C. The drawings are essentially diagrammatic, intended mainly to indicate the scope of work to be done. Equipment and material locations may be distorted for clearness in presentation.

1.06 SUBSTITUTIONS

- A. The use of manufacturers' names and catalog numbers followed by the phrase "or equal" is generally used to establish a standard of quality and utility for the specified items and to provide a dimensional reference for construction documents that are drawn to scale.
- B. Submittals for "equal" items shall, where applicable, include the following data which are not necessarily required for specified items:
 1. Performance characteristics.
 2. Materials.

3. Finish.
 4. Certification of conformance with specified codes and standards.
- C. Submittals of "equal" components or systems may be rejected if:
1. The material or equipment would necessitate the alteration of any portion of the mechanical, electrical, architectural or structural design.
 2. Dimensions vary from the specified material or equipment in such a manner that accessibility or clearances are impaired or the work of other trades is adversely affected.
- D. Proposed substitutions for materials or equipment must be submitted ten (10) days prior to final bid date with complete drawing documents for consideration as approved equals. Otherwise, such substitutions will not be permitted. Proposals for substitutions shall be made only by the prime bidders. Manufacturers, distributors, and sub-contractors shall not make proposals to the Architect for substitutions.
- E. No substitution shall be made unless authorized in writing by the Architect. Should a substitution be accepted and should the substitute material prove defective or otherwise unsatisfactory for the service intended, and within the guarantee period, the Contractor shall replace this material or equipment with material or equipment specified, at his own expense, and to the satisfaction of the Architect.
- F. Contractors submitting bids on substitute materials and equipment must also submit a bid on the "as specified" materials and equipment.
- G. Contractors submitting bids on substitute materials and equipment must also provide a written performance guarantee certifying that the substitute materials and equipment will produce the specified water effects.

1.07 SUBMITTALS

- A. The Contractor shall submit complete shop drawings to the Architect for approval, in quantities required for proper distribution and in accordance with the requirements of the General Conditions.
- B. Shop drawings shall include or incorporate those final drawings furnished by the Equipment Supplier, as specified herein, together with all additional information and drawings by the Contractor required in showing the proper installation of all equipment. Preliminary or schematic drawings provided by the equipment supplier shall not be used for installation.
- C. The Contractor shall deliver drawings for approval, after the signing of the contract, so as not to delay the construction required under other sections.
- D. Submittals may be rejected if they are difficult to read due to insufficient scale, poor image quality, poor drafting quality or if the required information is not included.

- E. Work shall not proceed until the Architect has approved submittals.

1.08 QUALITY ASSURANCE

- A. All workmanship and materials shall conform and comply with the requirements of building ordinances, codes, rules and regulations of all departments of Federal, State, county and city having lawful jurisdiction over the work in this section.
- B. When these specifications and/or drawings call for or describe materials, workmanship or construction of a better quality, higher standard or larger size than is required by the above mentioned rules and regulations, the provisions of these specifications and/or drawings shall take precedence over the requirements of said rules and regulations.
- C. The Contractor shall furnish, without extra charge, any additional material and/or labor required for compliance with these rules and regulations, although not mentioned in these specifications or indicated on the drawings.
- D. All materials shall be new and shall conform with applicable standards in every case where such standards have been established for the particular material in question.
- E. Workmen skilled in the craft that they are assigned shall execute all work.
- F. Adequate supervision shall be provided to maintain high quality workmanship.
- G. The Contractor shall provide labeled equipment-certifying approval, as hereinafter specified, by Underwriters Laboratories (UL).

1.09 SITE CONDITIONS

- A. The Contractor shall be responsible for the protection of the Owner's property from injury or loss due to his work. All damage to existing property (buildings, utilities, pavement, etc.) or planting (trees, shrubs, lawn or ground cover) caused by the Contractor during his operation or as a result of malfunction of installed work during the guarantee shall be repaired at the Contractor's expense.
- B. The Contractor shall fully inform himself regarding any available space limitations and unusual requirements, for the installation of all materials and work furnished under this section. Although the location of equipment may be shown on the drawings in certain positions, the Contractor shall also be guided by the Architectural details and conditions at the job, correlating his work with that of the other sections.

1.10 PERMITS AND FEES

- A. Permits: The Contractor shall secure and pay for all permits, inspections, and certificates of inspection, of any governmental and inspection body having jurisdiction over all or any part of the work included under this section, and/or such inspections, etc., required by these specifications.
- B. Fees: The Contractor shall secure and pay for all fees and assessments in connection with the work under this contract and shall include this cost in his bid and contract price.

1.11 GUARANTEE

- A. In entering into a contract covering this work, the Contractor accepts the specifications and drawings and guarantees that the work will be performed in accordance with the requirements of the specifications and drawings or such modifications to said specifications and drawings as may be made in the contract documents.
- B. The Contractor further guarantees that the workmanship and material will be of the best quality procurable and that none but experienced workmen, familiar with each particular class of work, will be employed.
- C. The Contractor further agrees to hold himself responsible for any defects which may develop in any part of the entire system, including equipment as provided for under this specification, due to faulty workmanship, design or material and to replace and make good, without cost to the Owner, any such faulty parts or construction which may develop at any time within one (1) year from the date of system startup. Any repairs or replacements required because of defects, as outlined in this clause, are to be made promptly and approved in writing by the Architect.

1.12 MAINTENANCE MANUAL

- A. The Equipment Supplier shall deliver to the Owner three (3) copies of the Operations and Maintenance Manual, together with any additional information or manuals that would assist in the proper maintenance of equipment.
- B. The Contractor shall arrange and provide for the technical instruction of the Owner's maintenance personnel, by the Equipment Supplier's personnel, for such time as is reasonably required to acquaint them with the operation and maintenance of all equipment furnished or installed under this section.

PART 2 PRODUCTS

2.01 GENERAL

- A. Prime contractor shall be responsible for purchasing all specialized fountain materials for the fountain and shall then furnish electrical fountain components to

the electrical contractor and mechanical fountain components to the mechanical contractor for installation and connection.

- B. Equipment not listed within these specifications or on drawings as furnished by the Equipment Supplier but required for the complete installation of the fountain mechanical and/or the Contractor shall furnish electrical systems, unless otherwise specified.
- C. Products shown on the drawings but not specified herein shall be provided in accordance with information shown on the drawings and the general provisions of this part of the specification.

2.02 SPECIALIZED FOUNTAIN MATERIAL SUPPLIER

- A. All Fountain equipment specified and supplied to the Contractor shall be supplied by a single fountain equipment supplier unless otherwise specified herein.
- B. The Equipment Supplier must currently be in the business of supplying fountain equipment for a minimum of ten years and shall have previously supplied fountain equipment similar in size and complexity.
- C. The Equipment Supplier shall also provide engineering design as it pertains to the fountain system and the equipment supplied, referring specifically to complete hydraulic and electrical design. This shall include display system, filtration system, water level control system and electrical control system design; pump selection and pump pit or equipment room sizing; piping system sizing, and suction pit and/or sump design; and lighting and junction box selection and layout.
- D. The engineering design information shall further be delineated on final schematic, installation, and detail drawings showing the proper installation of the supplier's equipment. These drawings shall be furnished to the Contractor by the Equipment Supplier as an integral part of his fountain equipment package.
- E. Approved Equipment Supplier: Fountain People, Inc. 4600 HWY. 123, San Marcos, Texas 78666. Contact: Bryan Had, telephone 770-366-3302, e-mail bryan.had@fountainpeople.com

2.03 MATERIAL SUPPLIER'S RESPONSIBILITY

- A. All materials and component parts, excluding lamps, supplied by the Equipment Supplier shall be guaranteed to be free from defects of materials and/or workmanship, for a period of one (1) year from date of fountain start-up.
- B. Design Responsibility: The Equipment Supplier shall accept complete design responsibility for the hydraulic and electrical system, providing that all equipment is supplied by him as indicated. This does not include responsibility for the actual

installation of the equipment except where the equipment is installed by the Equipment Supplier.

- C. Performance Guarantee: The Equipment Supplier shall provide a written performance guarantee certifying that the fountain system will perform to the designed water heights and patterns, and to create the designed lighting effects, provided the equipment is supplied by a single Equipment Supplier and the installation is in accordance with the supplier's recommendations and drawings.
- D. Any material supplied by the Equipment Supplier that is not actually manufactured by the Equipment supplier shall be supplied under the name of the particular equipment manufacturer's name.

2.04 Fountain Components

Item#	Qty	Model #	Description
^01	4	FWS-300	Waterstop Fitting, cast bronze coupling with integral waterstop flange, bonding lug and 4" female threaded connections.
02	4	DIV-PL-884U	DIV-PL Series Diverter Plate; consists of a 1/8" thick brass (C-channel) bent plate. Construction is brushed natural finish with 5/16" clearance holes for a 1/4" stainless anchors, by installer.
^03	2	R-84-6	Anti-Vortex Plate & Sump, heavy-duty frp construction with black gel coat interior finish, integral waterstop, and 6" sealed PVC pipe connection. Includes a 21" square anti-vortex/diverter plate of cast bronze with integral stand-offs and stainless steel fasteners.
^04	1	FFD-200	Floor Drain with Plug, cast bronze with integral waterstop flange, grounding screw, threaded bronze plug, and 2" female threaded connection.
^05	1	FSD-300	Overflow Standpipe Drain, cast bronze body with integral waterstop flange and ground screw, cast bronze cap, copper standpipe, 3" FNPT connection.
^06	1	CWL-002C	Conduit Mounted Water Level Sensor, cast bronze housing base with spun brass cover, dual function water level sensor with 30 feet of integral cable, 3/4" adjustability range. 1/2" female threaded conduit connection.
^07	1	FWS-050	Waterstop Fitting, cast bronze coupling with integral waterstop flange, bonding lug and 1/2" female threaded connections.
^08	2	ST-EF-200	Adjustable Eyeball Inlet Fitting, constructed of machined cast bronze and brass with bonding screw, 5/8" orifice eyeball, and 2" (F) N.P.T. connection.
09	7	FXPRO-FS-32	LED Underwater Light Fixture with on-board DMX driver, RGBW diodes, UL listed, type 316L stainless steel construction, adjustable stainless steel yoke assembly, tempered glass lens, and 19 feet of 18/5 cable. 24VDC, (8) diodes, 32 Watts.
10	1	JB8-3-100	Junction Box, conduit or flush mount, UL listed, underwater cast bronze junction box with internal grounding lug, neoprene gasket, 1" power connection, and three (3) side connections for lights.

11	1	JB8-4-100	Junction Box, conduit or flush mount, UL listed, underwater cast bronze junction box with internal grounding lug, neoprene gasket, 1” power connection, and four (4) side connections for lights.
^12	2	FWS-100	Waterstop Fitting, cast bronze coupling with integral waterstop flange, bonding lug and 1” female threaded connections.
13	4	PC-8882-D	Potting compound for use in underwater junction boxes, 21 oz. package, meets NEC article 680 as an approved potting compound.
14	1	DBVB-23527 Hardscape Hatch	Direct Burial Vault, fully pre-assembled and tested heavy duty FRP vault (5’-4” x 4’-10” x 5’-3” deep) with gel-coat interior and exterior, furnished with ¼” aluminum plate re-enforced tile-set hardscape access hatch with compression spring operators for placement in hardscape. The vault includes a 7.5HP thermoplastic self-priming pump with integral basket strainer, sand filter (or cartridge filter), erosion style chemical feeder, suction & discharge valve assemblies, water level fill manifold with ¾” solenoid valve, 1/3HP sump pump with 2” drain connection, 4” connection forced air ventilation system, and a UL listed electrical control panel in NEMA enclosure with motor starter, LED power supplies, Niclaudi U9 light controller, water level control relays, 24/7 digital timeclock, HOA switches, and a main disconnect switch. Unit is factory engineered, assembled and tested prior to shipment. Power requirement: tbd.
15	2	VCA-400-P	Vent Cap Assembly, PVC construction, 4” connection

^ ITEM REQUIRED FOR FOUNTAIN CONCRETE POUR.

PART 3 EXECUTION

3.01 SITE AND DRAWING EXAMINATION

- A. Any Contractor submitting a proposal for this work shall first examine the site of the proposed work and all conditions at the site that he may fully understand any facilities, difficulties, and restrictions attending the execution of the contract. No subsequent allowances shall be made because of omission, error, or negligence in connection with this provision.
- B. Any Contractor submitting a proposal for this work shall carefully examine the architectural and structural drawings and specifications for the work in this particular trade.
- C. Questions pertaining to work that does not appear to be sufficiently detailed or explained, or pertaining to the true meaning of any part of the drawings or specifications, or discrepancies found existing in or between the specification and/or drawings, shall be referred to the Architect for clarification or correction.

3.02 COORDINATION

- A. The Contractor shall cooperate with subcontractors of other trades, whose work is in any way affected by, or affects the work under this section.
- B. The Contractor shall also coordinate the work under this section with that of other trades, as required, to effect a completely satisfactory installation consistent with the requirements and intent of the contract drawings and specifications, to avoid omissions and delays in the work.
- C. The Contractor shall furnish necessary materials in ample quantities as required to avoid delay in the progress of the work and shall so store them as to prevent interference with other work.

3.03 GENERAL INSTALLATION

- A. Install and connect all equipment in accordance with manufacturer's instructions and recommendations unless otherwise noted. If specified installation is contrary to manufacturer's instructions, cease installation of affected components or systems. Notify Project Manager and Architect/Engineer and do not resume installation without clear instructions.
- B. Protect all pipes, conduits, equipment and other parts of the work against injury by exposure to the weather during construction while stored and after installed in place.
- C. Accurately locate items to be cast in concrete and rigidly support to resist loads imposed during concrete pour.

3.04 DIRECT-BURIAL VAULT SYSTEM INSTALLATION

- A. General:
 - 1. Installation shall be in strict accordance with manufacturer's instructions and recommendations.
 - 2. Handle vault with forklift or lift using the provided lifting lugs. Rig vault so all lugs see equal lifting force.
 - 3. Vault system must be protected at all times from flooding. Conduit and vent piping entries shall be protected from moisture entry prior to connection and drain piping and/or temporary power supply for sump pumps shall be connected immediately upon placement in excavation.
 - 4. Vault piping and conduit connections shall not be externally loaded or used to support piping or conduit.
 - 5. Vent piping, where required, shall not exceed twenty feet in length and ends of vent piping shall be protected with screen to prevent entry of insects.
- B. Install as follows:

1. Excavate as required and pour a flat ballast slab as per manufacturer's instructions.
2. Place vault into excavation and anchor to ballast slab using the stainless steel anchor cables provided by manufacturer.
3. Connect drain piping and/or temporary power to sump pump where required.
4. Connect all piping and conduit.
5. Pressure test-piping system.
6. Connect vent piping and protect openings.
7. Connect wiring to lugs and terminals provided in vault panel.
8. Install backfill material around vault.
9. Install vent pipe caps and screen.

C. Backfilling:

1. Backfill material shall be free-flowing gravel or crushed stone and shall be a nature rounded aggregate of 1/4" nominal size. Do not use sand or dirt for backfill.
2. A minimum of two feet of backfill material shall be provided between the vault and surrounding earth on all sides of vault. Top of vault may be backfilled with soil as specified by Architect up to a depth of twelve inches. If top of vault is located more than 12" below final grade, backfill material as described in #1 above, shall be provided between the vault and soil layer above vault.

D. Filter Media Installation

1. Filter media, where required, shall be installed in strict accordance with written instruction from manufacturer. Media must be installed in filter tank prior to circulating water through filter. Operation of filter without media may damage filter.

3.05 VALVE INSTALLATION

A. General:

1. Provide isolation valves on each side of all pumps, strainers, filters or any other device or equipment that must be isolated for maintenance.
2. Provide throttling valves in discharge piping which supplies nozzles, waterfall diverters or any device or equipment which requires flow to be throttled or adjusted.
3. Provide check valves in discharge piping that connects two or more pools of different elevations to prevent backflow.
4. Valves with stems shall be installed with stem horizontal or above. Do not install with valve stems below horizontal centerline.
5. Angle valves shall close against pressure.

B. Applications:

1. Isolation valves shall be gate, ball or butterfly unless otherwise specified.
2. Throttling valves shall be globe, ball or butterfly. Butterfly valves used for throttling must be equipped with infinite control handles up to 6" in size and hand wheel operators for sizes larger than 6".
3. Valves installed underwater or underground shall be of all non-corrosive material and furnished with non-corrosive handles or operators.

3.06 PIPE INSTALLATION

A. General:

1. Install piping straight and true without loops or traps in accordance with the best modern practice.
2. Make pipe runs as direct as possible using a minimum number of fittings.
3. Slope piping to the pump for drainage. If piping cannot be sloped to pump, make provision for the complete draining of each pipe line by connecting minimum a 1-1/2" drain line and valve to lowest point in pipe run.
4. Pump suction piping shall be a straight run into the pump free of pipe bends or tees for a minimum of ten pipe diameters preceding the pump's suction connection unless otherwise indicated on drawings.
5. Pump suction piping reduction 4" or larger shall be made with eccentric type fittings to eliminate the entrapment of air in the suction piping.
6. Cut pipe and tubing ends square. Remove rough edges and burrs so that a smooth and unobstructed flow will be obtained.
7. Cut pipe to measurements established at the site. Work into place without springing or forcing.
8. Protect all openings in piping during construction to prevent entrance of foreign matter.
9. Provide flanges or unions as indicated and as necessary to allow removal and re-installation of any item of equipment or accessory without cutting, welding or soldering.
10. All connections between dissimilar metals shall be made with dielectric fittings.
11. Arrange exposed piping straight, parallel and perpendicular to the walls of the structure unless otherwise shown on the drawings.
12. All city water lines connected to fountain system shall be protected by a backflow preventer approved for application and a pressure regulator which limits supply pressure to a maximum 50 psi.

B. Pipe joints:

1. Welded pipe: Perform all welding in accordance with the requirements of ASME Boiler Pressure Piping Code or ANSI B31.1.
2. Threaded pipe:

- a. Cut all threads with axis of thread coinciding with axis of pipe.
 - b. No more than two threads shall show beyond fittings.
 - c. Make up joints with Teflon tape or paste.
 - d. Remake leaky joints with new materials.
3. Compression copper joints:
- a. Use soft tubing.
 - b. Cut ends using tubing cutter. Ream and clean.
 - c. Install tube fitting as per manufacturer's instructions.
4. PVC pipe:
- a. Bevel all pipe ends with a coarse file or beveling tool.
 - b. Clean surfaces to be joined of all loose dirt and moisture from the I.D. and O.D. of the pipe end and the I.D. of the fitting socket.
 - c. Apply a coating of appropriate primer to the entire I.D. surface of the fitting socket and to an equivalent area on the O.D. of the pipe end.
 - d. Apply solvent cement using an appropriate natural bristle brush as follows: Apply a liberal coating or cement around the entire perimeter of the pipe end to a width slightly more than the equivalent socket depth of the fitting. Apply a light but complete coating once around the entire depth of the socket surface, avoiding excessive cement application. Apply a second liberal coating onto the pipe end.
 - e. Immediately after cementing, insert the pipe into the fitting to the full socket depth while rotating the pipe or fitting one-quarter turn. Hold joint together for at least 15 seconds after joining to make sure pipe does not back out of socket.
 - f. Do not disturb or move the joint for at least one hour after joining.
 - g. Do not solvent weld pipe if atmospheric temperature is below 40 degrees F. or above 90 degrees F., or if it is raining.
 - h. Discard cement when an appreciable change in viscosity takes place or if cement is lumpy or stringy. Do not thin. Cement must be used before the expiration date shown on the container.
- C. Underground piping:
1. Excavate trenching for underground piping to required depths providing sufficient slope for proper pipe fall and adequate space at both sides and bottom of trench to facilitate pipe installation.
 2. Tamp trenches hard.
 3. Install piping on 6" deep bed of pea gravel in the bottom of trench.
 4. Perform piping tests before coating or wrapping pipe.
 5. Backfill trench with pea gravel to a height of 12" above top of pipe.
 6. Backfill to surface in 6" layers with a minimum of 95% compaction. At paved areas, material may be gravel, or native soil. At planted areas, soil shall be as specified by the Architect.
- D. Pipe protection:
1. Copper, encased in concrete: Exterior shall be wrapped with one layer of pipe wrap at half lap.

2. Copper piping, underground: Exterior shall be coated with two coats of coal tar mastic to a total thickness of 8 to 10 mils. Allow 12 hours drying time between applications. Clean and prepare pipe exterior in accordance with manufacturer's recommendations.

E. Penetrations:

1. Core drilling for pipe penetrations shall be accomplished only at locations and in a manner approved by the Architect.
2. Provide a metal sleeve or core drilled hole for every pipe passing through a concrete wall or floor.
3. Provide a waterstop or membrane clamp for every pipe or sleeve penetrating an exterior concrete wall or floor or the fountain wall or floor, whichever is appropriate to the waterproofing method and as shown on the drawings.
4. Seal sleeves passing through exterior walls with resilient seal and foam sealant, or as indicated on the Drawings.

3.07 UNDERWATER LIGHT FIXTURE INSTALLATION

- A. Install underwater lighting fixtures in accordance with Article 680 of the National Electrical Code (NEC) and as per manufacturer's instructions.
- B. Secure underwater light flexible cords to junction boxes using brass compression type strain relief seals approved for application.
- C. Exposed underwater flexible cords may not exceed 10 feet in length.
- D. Protect all underwater lighting circuits operating above 15 volts with a Class "A" ground fault circuit interrupter (GFCI). Circuits operating below 15 volts shall be protected by a transformer UL listed and marked for application.
- E. Provide sufficient flexible cord to allow underwater light fixtures to be removed from the water for re-lamping and normal maintenance.

3.08 UNDERWATER JUNCTION BOX INSTALLATION

- A. Install underwater junction boxes in accordance with Article 680 of the National Electrical Code (NEC) and as per manufacturer's instructions.
- B. Install all junction boxes connected to underwater light fixtures, but located outside of fountain basin, as an underwater junction box if not located 4 feet or more from pool and 8" or higher above maximum pool water level.
- C. Underwater junction boxes shall be sealed after being wired as follows:
 1. Seal all conduit openings using duct seal or other approved sealant.
 2. Make sure all wiring connections are grouped in center of box away from box walls and recessed below opening.

3. Fill junction box completely with potting compound to encapsulate electrical connections and prevent moisture entry.

3.09 CONDUIT INSTALLATION

- A. Install wiring in sealed conduit in accordance with best modern practice, except flexible cord approved for submersible application shall be used between underwater light fixtures and underwater junction boxes.
- B. Applications (Unless otherwise indicated on drawings):
 1. Conduit located within pool and all stub-ups through pool floor or walls shall be red brass.
 2. Conduit located in equipment room or exposed to sunlight shall be steel.
 3. Buried conduit shall be PVC.
- C. Conceal conduit located in finished areas unless otherwise indicated on drawings.
- D. Cut ends of all conduit square and carefully ream to remove rough edges.
- E. Seal ends of conduit during construction to prevent entry of moisture or contaminants.
- F. Provide a bushing to protect conductors from abrasion where conduit enters a box or other fitting.
- G. Where junctions, bends or offsets are required on exposed runs of conduit, fittings with accessible covers shall be provided. Bends around corners of beams, walls or equipment will not be permitted.
- H. Do not use threadless couplings and/or connectors with conduit installed in wet locations or where buried in concrete or other fill. All threads shall be NPT (tapered pipe threads) run up tight with Teflon tape or sealant. Running threads will not be permitted.
- I. Bend conduit so that conduit is not damaged and such that the inside diameter is not effectively reduced. No more than the equivalent of two 90-degree bends shall be used on any single run of conduit between accessible outlets and/or other fittings.
- J. Provide dielectric fittings for all connections made between dissimilar metals.
- K. Seal all conduits after conductor installation to prevent entry of moisture.

3.10 CONDUCTOR INSTALLATION

- A. Install conductors in conduit after conduit has been installed and all moisture and debris have been removed from conduit, junction boxes and other conduit fittings.

- B. Install conductors connected to equipment having a tendency to cause noise or vibration in flexible conduit not to exceed four feet in length. Cover all flexible conduit subject to moisture with watertight plastic and make all connections with watertight fittings.
- C. Install only stranded type copper conductors with waterproof insulation between underwater junction boxes and Fountain Control Panel. Do not use solid copper conductors.
- D. Do not use cleaning agents or lubricants that might have a deteriorating effect on conductor coverings.
- E. Make all electrical connections to mechanical equipment as required to place this equipment in operating service.
- F. Connect conductors to terminals using approved connectors. Wires in panel cabinets, pull boxes, and wiring gutters shall be neatly grouped and fanned out to the terminals.

3.11 CONDUCTOR COLOR CODING

- A. Color code conductors (600 volts and under) and identify by one color with continuity being maintained throughout the project.
- B. Color code as follows:
 - 1. Phase "A" - Black.
 - 2. Phase "B" - Red.
 - 3. Phase "C" - Blue.
 - 4. "Neutral" - White.
 - 5. "Ground" - Green.

3.12 EQUIPMENT IDENTIFICATION

- A. Provide a securely attached permanent nameplate for each piece of equipment, where appropriate, containing all data required to properly identify the equipment, (i.e., manufacturer, type, size, capacity, horsepower, etc.).
- B. Provide a permanently attached valve tag of non-corrosive material for each valve, to provide information to correlate the valve with the outlet or fitting served.
- C. Provide a legible copy of the "As-built" schematic diagram, permanently encased in plastic or glass, to provide the Owner's operating personnel ready correlation of each valve identified with each outlet or fitting served.

- D. Provide nameplates for all pressure and/or compound gauges, pressure switches, vacuum switches and other sensory or control devices to identify and provide information to correlate the device to operation and maintenance manual.
- E. Provide nameplates on exterior of all electrical panels to identify panel and designate maximum voltage within panel.
- F. Provide labels for all panel control switches and pilot lights to identify equipment controlled and function.
- G. Provide labels in all power distribution panels designating device connected to each circuit breaker.
- H. Provide labels on each time clock, control relay, contactor, and motor starter within control panels to identify and provide information to correlate the device to panel electrical drawings.

3.13 RECORD DRAWINGS

- A. The Contractor or subcontractor shall keep on the job, one complete set of contract working drawings, on which he shall record any deviations or changes from such drawings made during construction. The record drawings shall show changes in size, type, capacity, etc., of material, device or piece of equipment, rerouting of any piping or conduit, or changes in other building services.
- B. These drawings shall also record the location of all concealed services, piping, conduit and other equipment, by indication of measured dimensions to each such line, from readily identifiable and accessible reference points.
- C. Before the date of the final inspection, the Contractor shall transfer all information from the "as-built" prints to a sepia Mylar procured from the Architect at cost. All work shall be neat, in ink and subject to the approval of the Architect.
- D. After final acceptance the approved sepia drawings shall be delivered to the Architect in good condition, as a permanent record of the installation as actually constructed.

3.14 DEFECTIVE WORK AND MATERIALS

- A. All materials or work found to be defective or not in strict conformity with the drawings, or different from the requirements of the drawings and specifications, or defaced or injured, shall be removed and satisfactory material and work substituted.

3.15 CLEAN UP

- A. Upon completion of the work of this section, the Contractor shall remove all unused equipment and implements of service, and leave the entire area involved in a neat, clean, and acceptable condition as approved by the Owner.
- B. All soiled, abraded or discolored surfaces of decorative fountain work shall be cleaned, polished and left free from blemishes or defects.
- C. All water pipe lines shall be flushed free of debris as follows:
 - 1. Completely drain all piping and equipment.
 - 2. Remove all construction debris and thoroughly sweep pools clean.
 - 3. Fill the system to the required capacity.
 - 4. Circulate the water throughout the system for one hour, using the display pump. Do not allow cloudy water to pass through the filter tank.
 - 5. Completely drain pool, piping and equipment and remove all debris that may have collected in suction and/or discharge strainers.

3.16 TESTS AND ADJUSTMENTS

- A. General: The Contractor shall test all equipment installed by him, as necessary, to show that it complies with all requirements specified. Testing shall be done in a manner approved by the Architect.
- B. Piping tests:
 - 1. Provide all temporary piping, pumps, and gauges necessary to conduct the specified tests.
 - 2. Conduct all tests before concealment of work and before any coating, paint or wrap is applied.
 - 3. Use water as test medium. Do not test piping with air or any other compressible gas. Vent air from all piping being tested before applying pressure.
 - 4. Replace or repair any part that leaks. Repeat test until criteria are met.
 - 5. Do not subject any item to a test pressure greater than the pressure rating of the item.
 - 6. Underground piping shall be tested as follows:
 - a. Pressurize all underground piping (except for drain system) to 40 psi prior to backfilling (spot backfilling to anchor piping may be done prior to pressurizing). Piping shall remain pressurized until all backfilling, grading, planting and concrete work in the area of the piping is completed.
 - b. Pressurize all underground drain piping beneath the equipment space to 15 psi prior to backfilling (spot backfilling to anchor piping may be done prior to pressurizing). Piping shall remain pressurized until all backfilling and concrete work in the area of the piping is completed.
 - 7. The completed piping systems shall be tested as follows:
 - a. Conduct each test for a minimum continuous duration of eight hours.

- b. Hydrostatically pressure test all storm and sanitary drain piping at 15 psi.
 - c. Hydrostatically pressure test all other piping and equipment at 40 psi.
 - d. Strike all solder joints with a soft-face hammer while under pressure.
 8. Log pressure readings for all tests required at the beginning and end of each test. Note the location and cause of any failures and method of repair on a daily log. Submit copy of log to the Architect.
- C. Electrical tests:
 1. All electrical circuits, feeders, and equipment shall be tested and proven free of improper grounds, open circuits or shorts, as required by the public authorities, to demonstrate compliance with codes or laws.
- D. The Contractor shall, at his expense, make the fountain operational using an authorized Technician from the Equipment Supplier and make tests, adjustments, and corrections, until it is shown to be in proper operating condition.

3.17 THIRTY-DAY OPERATION PERIOD

- A. As soon as the fountain structure has been completed and all-mechanical and electrical equipment has been installed and tested, the fountain may be placed in operation.
- B. Prior to acceptance of the installation by the Owner, the Contractor shall demonstrate a concurrent thirty-day, fully automated, uninterrupted daily operation of not less than twelve hours nor more than twenty hours for all systems provided under this section.
- C. The Contractor shall supervise the operation of the equipment and be responsible for the proper operation and maintenance thereof and make no claim against the Owner for any damage to the equipment during such operation. The Contractor shall make such changes, adjustments, or replacements of equipment as may be required to make the installation comply with the Specifications, or to replace any defective parts or materials.
- D. The Owner will pay water and normal operational supplies during the thirty-day operation period the costs of electricity. The Contractor shall pay for all operating costs resulting from system deficiencies.

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Include evidence of NRTL listing for SPD as installed in panelboard.
 - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 8. Include wiring diagrams for power, signal, and control wiring.
 - 9. Key interlock scheme drawing and sequence of operations.
 - 10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 FIELD CONDITIONS

- A. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- 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.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Height: 84 inches (2.13 m) maximum.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- F. Incoming Mains Location: Bottom.
- G. Phase, Neutral, and Ground Buses: Tin-plated aluminum.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum.
 - 2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.

- I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
- K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- E. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - 2. MCCB Features and Accessories:

Not all accessories and options listed in subparagraphs below are available for every rating and from every listed manufacturer. Verify availability and unique characteristics with manufacturers selected. Indicate on Drawings features that apply to selected overcurrent devices.

- a. Standard frame sizes, trip ratings, and number of poles.

- b. Breaker handle indicates tripped status.
- c. UL listed for reverse connection without restrictive line or load ratings.
- d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
- e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
- f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NEMA PB 1.1.
- C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
- G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- H. Install filler plates in unused spaces.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- 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 for low-voltage air circuit breakers stated in NETA ATS. 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.
- 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, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

SECTION 31 11 00 – CLEARING & GRUBBING

PART 1 - GENERAL

1.01 SUMMARY

- A. Clearing work covered under this Section consists of cutting, removing, and properly disposing of trees, grass, undergrowth, and debris. Trees specifically identified on Drawings to be preserved shall be adequately delineated and flagged by Contractor such that balance of work may be performed in a safe and harmless manner in vicinity of preserved trees. Such tree preservation will be considered part of work and shall be in conformance with applicable local codes and regulations.
- B. Grubbing work covered by this section consists of removing and properly disposing of all surface vegetation and debris. Usable topsoil shall be retained as described in this Section. The top 6 inches of surface material (at a minimum) shall be removed during grubbing. Additionally, remove remaining material containing roots, root mat, and vegetation.
- C. Work of clearing and grubbing shall also include removal and satisfactory disposal of crops, weeds, and other annual growth; removal and satisfactory disposal of fences, steps, walls, chimneys, column footings, other footings, foundation slabs, basements, other foundation components, signs, junked vehicles, and other rubble and debris; and filling of holes and depressions. This work shall also be performed in all non-wooded areas within construction limits, shown on Drawings, upon which seeding and mulching, sprigging or sodding is to be performed.
- D. Clearing and grubbing operations shall be completed sufficiently in advance of grading operations as may be necessary to prevent any of debris from clearing and grubbing operations from interfering with excavation or embankment operations.
- E. Contractor shall obtain, at his own expense, all necessary permits pertaining to clearing and grubbing work not already secured by Owner. Contractor shall then provide a copy of all required permits to Owner.

PART 2 - PRODUCTS

2.01 TOPSOIL

- A. Topsoil shall be considered to mean original surface soil, typical of area, which is capable of supporting native plant growth, and shall be free of large stones, roots, brush, waste construction debris and other undesirable material or contamination.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Clearing and grubbing shall be performed in areas as called for on Drawings, the limits of which shall coincide with construction limits and in general shall extend 5 feet beyond top of cut or toe of fill, not to exceed limits of Owner's property. Clearing and grubbing activities shall conform to following referenced standard, except that grubbing shall be performed on all cleared excavation and embankment areas and shall include complete removal of all stumps, roots and embedded debris:
- B. Contractor shall perform all clearing and grubbing operations before construction operations begin, or in phases approved by the Architect.
- C. Where adjacent areas within site but outside limits of construction are disturbed as a result of clearing and grubbing activities, Contractor shall remove all debris, re-establish original grades, and restore areas to a condition equal to or better than that existing prior to disturbance.
- D. Contractor shall exercise caution to protect and maintain all existing utilities and underground works which are to remain. Any existing utilities or underground works which are to remain that are disturbed during construction shall be repaired or replaced at Contractor's expense.
- E. Contractor must comply with all local, state and federal laws, ordinances and regulations in removal and disposal of clearing and grubbing of all vegetation, timber, waste and all surface debris that must be hauled from the project site. No burning or burying of materials will be allowed on site. Contractor shall properly dispose of all cleared materials at his expense, in conformance with all applicable local and state laws and ordinances, with exception of any materials to be reused or recycled as directed elsewhere in this contract.
- F. Stripping and Storage of Topsoil:
 - 1. All topsoil suitable for reuse, shall be stripped to its full depth. All topsoil to be reused shall be free of large stones, roots, brush, waste construction materials and other undesirable matter.
 - 2. Topsoil stripping shall be accomplished from all topsoiled areas to be disturbed.
 - 3. Existing lawn sods may be left to decompose with topsoil. Heavier stands of weeds and grasses shall be removed as directed by Owner prior to stripping operations.
 - 4. Topsoil shall be kept separate from other excavated materials and stored in stockpiles, location of which shall be as directed by owner. Topsoil shall be stockpiled so that it shall not be subject to abnormal erosion and loss, and so that it

does not impede flow of drainage runoff. Stockpiled soil shall be protected on its downstream side with a single row of silt fence. Directed locations of topsoil stockpiles will, when construction sequence permits, be located in areas that have previously been graded to design rough grade.

5. Any excess topsoil shall be disposed of as directed by Owner at Contractor's expense.

END OF SECTION 31 11 00

SECTION 31 20 00 – EARTH MOVING

PART 1 – GENERAL

- A. **Related Work:** Refer to drawings for work to be completed under this section. The contractor shall obtain and read the geotechnical report for the project. The report may be obtained from the Architect.
- B. **Description of Work:** The extent of earthwork is shown on drawings, and includes preparation of subgrades for building pad, sidewalks, landscape areas, pavement subgrades, and placement of topsoil.
- C. **Quality Assurance:** Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

Soil tests, field density tests and testing of footing subgrades and observation and report of pre-densification shall be made by a materials testing laboratory approved by the Owner and paid for by the Contractor.

- D. **Job Conditions:**
 - 1. **Existing Utilities:** Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
 - 2. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.

- 3. **Protection of Persons and Property:** Barricade open excavations occurring as part of this work and post with warning lights.

Operate warning lights as recommended by authorities having jurisdiction.

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

PART 2 - PRODUCTS

- A. **Satisfactory Soil Materials:** Satisfactory soil materials for fill material shall be limited to soils classified in accordance with ASTM D2487 as GM, GC, SW, SP, SM, SC, ML and CL.

Contractor shall be responsible for all testing including testing of borrow materials to determine suitability for use as fill material.

Backfill and Fill Materials: Satisfactory soil materials described above free of clay, rock or gravel larger than 2” in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

PART 3 - EXECUTION

- A. Excavation: Excavation consists of removal and disposal of material encountered when establishing required sub-grade elevations and invert elevations for utility trenches.

Earth excavation includes removal and disposal of material of any classification and other materials encountered that are not classified as unauthorized excavation or rock excavation.

Unauthorized excavation consists of removal of material beyond indicated subgrade elevations or dimensions without specific direction of the Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be at Contractor's expense.

Rock excavation includes removal and disposal of materials classified as rock that are encountered when establishing required finish grades, subgrades elevations or invert elevations. Removal of materials classified as rock excavation will be paid for on basis of contract conditions relative to changes in work.

Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Architect.

1. Additional Excavation: When excavation has reached required subgrade elevations, notify the Architect who will make an inspection of conditions.

If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by the Architect.

Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in work.

2. Stability of Excavations: Slope sides of excavations shall comply with applicable codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

Maintain sides and slopes of excavations in safe condition until completion of backfilling.

3. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.

Establish requirements for trench shoring and bracing to comply with applicable codes and authorities having jurisdiction.

Maintain shoring and bracing in excavations regardless of the time period that excavations will be open. Carry down shoring and bracing as excavation progresses.

4. Dewatering: Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.
Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Convey water removed from excavations and rainwater to collecting or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches. Do not permit construction drainage onto adjacent property.

5. Material Storage: Stockpile satisfactory excavated materials where directed, for backfill or fill. Place, grade and shape stockpiles for proper drainage. Soil stockpiles shall be surrounded with a single row of silt fence.

Locate and retain soil materials away from edge of excavations.

Dispose of excess soil material and waste materials as herein specified.

6. Excavation for Structures and Pavements: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10' and extending 10 feet from foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

Contractor shall grade the buildings subgrades to allow for the required concrete slabs. Depth of subgrade below finished contours and elevations shall be as indicated in the Architectural Drawings. Refer to Paving Sections for subgrade depths.

7. Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room for compaction.

Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations.

Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.

Do not backfill trenches until tests and inspections have been made and backfilling authorized by the Architect. Use care in backfilling to avoid damage or displacement

of pipe systems.

B. Pre-Densification and Proofrolling:

1. General: At completion of clearing, grubbing and stripping of topsoil, stump holes or other depressions shall be cleared of loose material and debris and shall then be backfilled with approved fill. The backfill shall be placed in eight-inch-thick loose lifts and compacted to 95% density in accordance with ASTM D698.

Each building pad and all paving subgrade areas shall be compacted and pre-densified as recommend by the geotechnical engineer. All areas that are unstable under the compaction equipment shall be undercut to firm soil and replaced with clean fill compacted as specified in eight-inch loose lifts. Pre-densification shall be observed by an experienced geotechnical engineer. Pre-densification shall be accomplished with a fully loaded dump truck (20-ton min.) or other rubber-tired equipment. Over lapping passes of the vehicle shall me made across the site in one direction, and then at right angles to the original direction.

C. Compaction:

1. General: Control soil compaction during construction providing the percentage of density specified for each area classification.
2. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture density relationship determined in accordance with ASTM standards; and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship.
3. Building Pads and Utility Trenches Outside of Pavement Subgrades: Compact to at least 95 percent of the maximum dry density. (ASTM D698).
4. Pavement Subgrade and Utility Trenches within Pavement Subgrades: Compact to at least 95 percent of the maximum dry density (Modified Proctor – ASTM D1557).
5. Pavement Graded Aggregate Base Courses: Compact to at least 100 percent of the maximum dry density (Modified Proctor – ASTM 1557).
6. Landscape Areas: Compact to at least 95 percent of the maximum dry density (ASTM D-698).

D. Backfill and Fill:

1. General: Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.

In excavations, use satisfactory excavated or borrow material.

Under grassed areas, use satisfactory excavated or borrow material.

Under walks and pavements, use subbase material, or satisfactory excavated or borrow material, or combination of both.

Backfill excavations as promptly as work permits, but not until completion of the following:

Removal of concrete formwork.

Removal of shoring and bracing and backfilling of voids with satisfactory materials.

Removal of trash and debris.

2. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

When existing ground surface has a density less than that specified under "Compaction" for particular area classifications, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

3. Placement and Compaction: Place backfill and materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment and not more than 4" in loose depth for material compacted by hand operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.

E. Grading:

1. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades. Grade areas adjacent to pavement to slope as

indicated on the drawings and to prevent ponding of water in paved areas. Backfill against curbs and pavement edges flush to provide a smooth finish in areas to be grassed.

2. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Grade as per details on the Drawings.

Finish surfaces free from irregular surface changes, and as follows:

Lawn Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required elevations. Areas shall be free of stones, pebbles, etc. 3/4" and larger. Finish grading of lawns and other areas to be grassed shall be fine graded using hand rakes and small rubber-tired tractors with box blades. Fine graded areas shall be pulverized with a Gill Pulverizer or equal equipment.

Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 1/2" above or below required subgrade elevation.

3. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2" when tested with a 10' straightedge. Extend fill beyond perimeter of footings a minimum of 5 feet.
4. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

F. Field Quality Control:

1. Quality Control Testing During Construction: Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed. An experienced geotechnical engineer shall observe the pre-densification of the building pads and pavement subgrade areas. Submit one copy of results of all Compaction Test and observations of pre-densification to Owner, Architect and Engineer. Perform field density tests in accordance with ASTM D 2937 (drive cylinder method), ASTM D 2167 (rubber balloon method), as applicable, or nuclear method ASTM D 2922.

Building Subgrade Areas: Make at least one field density test for each 12" layer of subgrade for every 2,500 sq. ft. of subgrade area.

Geotechnical firm shall have a qualified representative on site on a full-time basis during subgrade evaluation and fill placement for all building subgrade areas.

Pavement Subgrade Areas: Make at least one field density test for each 12" layer of subgrade for every 5,000 sq. ft. of pavement subgrade area.

Footings Subgrades: All footing subgrades shall be examined by an experienced

geotechnical engineer or his representative immediately prior to placement of reinforcing steel. Auger and penetrometer testing, augmented by hand probing, shall be performed on all footings in accordance with the following:

Auger and penetrometer testing: One test for each 25 lineal feet of footing subgrade.

Probe rod testing: One test for each spread footing and one test for each 10 lineal feet of continuous footing.

Landscape Areas: Make at least one field density test for each layer of subgrade for every 5,000 sq. ft. of landscape areas.

If in opinion of Architect, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.

G. Maintenance:

1. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

2. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

H. Insufficient Fill Material: The Contractor shall be responsible for locating, testing, purchasing, hauling, spreading and compacting all required fill material. See paragraph, 2. - Products, for fill requirements.

- I. Excess Cut Material: If the quantity of onsite excavated material, is in excess of the quantities necessary to provide finish grade elevations indicated on the drawings, the excess material shall be disposed off-site by the Contractor at no additional cost to the Owner.

END OF SECTION 31 20 00

SECTION 31 22 00 - GRADING

PART 1 - GENERAL

1.1 Summary:

A. Section Includes:

1. Grade sub-soil and reform to grades, contours and levels.
2. Rough grade for roadways, walks, curbs, parking areas, landscaped areas, and stormwater ponds.
3. Dust and erosion control.

B. Related Sections: Selective Site Demolition, Section 02 41 13.

1.2 References:

A. American Society for Testing and Materials (ASTM):

1. ASTM D1557 - Test Methods for Moisture - Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. (4.54 kg) Rammer and 18 inch (457 mm) Drop.
2. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 5.5 lb. (2.49 kg) Rammer and 12 inch (304.8 mm) Drop.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. M145 - The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

1.3 Existing Conditions:

- ##### **A. Verify existing site conditions prior to commencing operations. Locate existing site utilities, per Section 31 20 00.**

1.4 Protection:

- ##### **A. Protect trees, shrubs and lawns and other features remaining as part of final landscaping.**
- ##### **B. Protect benchmarks and existing structures, fences, roads, underground utilities, and paving against damage from equipment and vehicular traffic.**
- ##### **C. Protect aerial, surface, or underground utility lines or appurtenances which are to remain.**

D. Repair damage to existing areas to remain. PART 2 - PRODUCTS

2.1 Materials:

- A. Excavated Fill Material: Soil free from roots, rocks larger than 3" and building debris consisting of sand, silty sand and clayey sand with less than 35 percent by dry weight passing the U.S. Standard No. 200 sieve.
- B. Additional Fill Material: AASHTO Designation M145, soil classification group A-1, A-3, A-2-4, A-2-5.
- C. Select Fill Material: Clean, non-plastic sands excavated from the site containing less than 20 percent by dry weight passing the U.S. Standard No. 200 Sieve. Material shall be free of organic and deleterious substances.

PART 3 - EXECUTION

3.1 Preparation:

- A. Establish and identify required lines, levels, contours and datum.
- B. Maintain benchmarks, monuments and other reference points. Re-establish if disturbed or destroyed, at no cost to Owner.
- C. Before start of grading, notify all pertinent utility companies 48 hours prior to digging for location of underground utility lines. Establish the location and extent of utilities in the work areas.
- D. Perform grading within contract limits, including adjacent transition areas to new elevations, levels, profiles and contours indicated. Provide subgrade surfaces parallel to finished surface grades. Provide uniform levels and slopes between new elevations and existing grades.
- E. Grade surfaces to assure areas drain away from structures and to prevent ponding and pockets of surface drainage. Provide subgrade surfaces free from irregular surface changes.
- F. Perform grading within branch spread of existing trees to remain by hand methods to elevations indicated. Cut roots if necessary with an axe, and coat cut roots with tree paint.
- G. Grade at excavations to prevent storm-water from draining into excavated areas.

3.2 Rough Grading:

- A. Rough grade site to required levels, profiles, contours and elevations ready for finish grading and surface treatment. Maintain the following:
 - 1. Sodded areas - 4 inches below finished grade elevations.

2. Paved areas - To below base material.
 3. Shrub beds - 4 inches below finished grade elevations.
 4. Concrete sidewalks - 8 inches below finished grade elevations.
- B. Prior to placing fill material over undisturbed subsoil, scarify surface to depth of 6 inches.
- C. Proofroll the underlying natural sub-grade layer beneath paved areas plus five feet beyond with a minimum of ten passes of a heavy vibratory roller. Refer to Section 31 20 00.
- 3.3 Dewatering:
- A. Dewatering may be required for some excavations. Dewatering shall be designed and operated to lower the groundwater table to a depth of approximately two feet below the bottom of compaction surfaces.
 - B. Dewatering discharges should be directed to the temporary sediment traps prior to discharge from the site.
- 3.4 Fill Types and Compaction (refer to Section 02300).
- 3.5 Erosion and Dust Control (refer to Section 02300):
- A. Provide erosion and dust control throughout the duration of the contract.
 - B. Methods of erosion control shall be in conformance with the permitted construction drawings.
- 3.6 Surplus Material:
- A. Remove surplus materials from site.

END OF SECTION 31 22 00

SECTION 31 32 11 – SOIL SURFACE EROSION

PART 1 - GENERAL

Description: This section consists of the furnishing and installing of silt fences, grassing, and other provisions as shown on the drawings for the purpose of governing land-disturbing activities. The measures implemented on site must, at a minimum, be in conformance with the requirements of the *Manual for Erosion and Sediment Control in Georgia*, latest edition.

PART 2 - VEGETATION

Stripping of vegetation, regrading and other development activities shall be conducted in such a manner so as to minimize erosion and sedimentation. Whenever feasible, natural vegetation shall be retained, protected and supplemented.

PART 3 - DISTURBED SOIL

The disturbed area and the duration of exposure to erosive elements shall be kept to a practical minimum. All disturbed soil shall be stabilized as quickly as practical. Temporary vegetation or mulching shall be employed to protect exposed critical areas during development.

PART 4 - EROSION CONTROL STRUCTURES

Structural erosion control measures must be installed as soon as practical. All structures shall be installed as described on the Drawings.

PART 5 - SURFACE RUN-OFF WATER

Sediment in run-off water must be trapped by the use of structural methods as described on the drawings until the disturbed area is stabilized. Adequate provisions must be provided to minimize damage from surface water to the cut face of excavations or the sloping surfaces of fills.

PART 6 - MAINTENANCE

The site Contractor shall be responsible for maintaining all erosion and sediment control measures and structures during the construction period. Additionally, the contractor is subject to the requirements of NPDES permit GAR 100001 regarding inspections, recordkeeping, stormwater sampling, and reporting.

PART 7 - REMOVAL OF SILT FENCING

The Contractor shall remove and dispose of all silt fencing, stakes, haybales, and etc. once the grassed areas are stabilized and landscaping is completed.

END OF SECTION 31 32 11

SECTION 31 50 00 – EXCAVATION SUPPORT, PROTECTION, & BACKFILL FOR UTILITY SYSTEMS

PART 1 - GENERAL

1.1 Scope:

- A. Under this heading shall be included the excavation, trenching and backfilling required for all underground utility systems.
- B. Utility systems include sanitary sewers, storm sewers, water piping and other underground utilities.

1.2 General:

- A. Underground piping and utility systems which are to be installed in trenches whose lowest point of excavation is below the existing ground level, and are unaffected by an excavation for structures, may be installed at any time during the course of the work. Piping and systems to be installed in or over fill, backfill or new embankments shall not be installed until all earthwork has been completed to rough grade, nor until settlement of the fill or embankment has taken place.
- B. Braced and sheeted trenches and open trenches shall comply with all applicable laws and regulations, and ordinances relating to safety, life, health and property. Also, this shall conform to applicable Federal Regulations.
- C. The sides and bottoms of the trenches shall be protected against any instability which may interfere with the proper laying of the pipe and as necessary for the safety of the workmen and others and as may be necessary to protect adjacent structures. Refer to safety requirements of the General Conditions and Special Conditions.

1.3 Location and Protection of Utilities and Structures:

- A. It shall be the responsibility of the contractor to acquaint himself with the location of all utilities and structures both present and proposed, also all existing surface structures which may be affected by work under the Contract. The location of any underground structures furnished, shown on the Plans or given on the site are based upon the available records but are not guaranteed to be complete or correct, and are given only to assist the Contractor in making a determination of the existence of underground structures.
- B. Overhead utilities, poles, etc., shall be protected against damage by the Contractor, and if damaged by the Contractor, shall be replaced by him. The Contractor shall notify those who maintain utilities sufficiently in advance of the proposed construction so that they may locate, uncover and disclose such work. If the progress of construction necessitates the removal or relocation of poles, overhead utilities and obstructions, the Contractor shall make all arrangements and assume all costs of the work involved.
- C. The Contractor shall provide for the continuance of the flow of any sewers, drains, water pipes, and water courses and the like. Where such facilities, water courses, or electric

overhead wires or conduits are interfered with by the work of the Contractor, the interruption shall be a minimum and shall be scheduled in advance with the Architect and the utility owner.

- D. The Contractor shall restore all facilities interfered with to their original condition or acceptable equivalent. The cost of such restoration or damage caused directly by his work shall be paid for by the Contractor and shall be included in the prices bid for the items to which it pertains.

1.4 Excavation and Trenching:

- A. Excavation: Excavate all materials encountered.
- B. Caution in Excavation: The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures and existing utilities in the trench zone may be determined before being damaged. He shall be held responsible for the repair or replacement of such structures when broken or otherwise damaged because of his or his subcontractor's operations.
- C. Subsurface Explorations: The Contractor shall make explorations and excavations at no additional charge to the Owner to determine the location of existing underground structures.
- D. Depth of Trench: Utilities and other piping shall be laid in open trenches as shown and specified. Trenches shall be excavated to the designated lines and grades, beginning at the outlet end and progressing toward the upper end in each case. Trenches for pipe shall be shaped to the lower 1/3 of the pipe and provide uniform and continuous bearing. Bell holes shall be dug to allow ample room for working fully around each joint.
- E. Width of Trench: Trenches shall be of minimum width to provide ample working space for making joints and tamping backfill. Width on each side of barrel of pipe shall be not less than 8 inches or more than 12 inches. Sides of trenches shall be closely vertical to 12" above top of pipe and shall be sheet piled and braced where soil is of unstable nature. Above the top of the pipe, trenches may be sloped. The width of the trench above this level may be wider for sheeting and bracing and the performance of the work.
- F. Alignment and Grade: Trenches shall be excavated on the alignments shown on the Plans, and to the depth and grade necessary to accommodate the pipes at the elevations shown. Where elevations of the invert or centerline of a pipe are shown at the ends of a pipe, the pipe shall be installed at a continuous grade between the two elevations.
- G. Overexcavation:
 - 1. Excavation in excess of the depth required for proper shaping shall be corrected by bringing to grade the invert of the ditch with compacted coarse, granular material at no additional expense to the Owner. Bell holes shall be excavated to relieve bells of all loads, but shall be small enough to insure that support is provided throughout the length of the pipe barrel.

2. Excavation in excess of the depths required for manholes and other structures shall be corrected by placing a subfoundation of 2000 psi concrete, at no additional expense to the Owner.
3. If trenches are excavated to widths in excess of those specified, or if the trench walls collapse, the pipe shall be laid in accordance with the next better class of bedding at the expense of the Contractor.

H. Solid Rock Excavation: Solid rock excavation or blast rock for trench excavation (if needed) shall be defined as any material which cannot be excavated with a backhoe having a bucket curling force rated of not less than 25,700 lb. (Caterpillar model 25 or equivalent) and occupying an original volume of at least 1/2 cubic yard.

1.5 Trenches:

- A. Trenches shall be maintained in a safe condition to prevent hazardous conditions to persons working in or around the trench.
- B. Braced and sheeted trenches and open trenches shall comply with all State and Federal Laws and Regulations, and local ordinances relating to safety, life, health and property.
- C. The top portion of the trench may be excavated with sloping or vertical sides to any width which will not cause damage to adjoining structures, roadways, utilities, etc. The bottom of the trenches shall be graded to provide uniform bearing and support each section of the pipe of undisturbed soil at every point along its entire length, except for the portions of the pipe sections excavated for bell holes and for the sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded and in order that the pipe rests upon the trench bottom for its full length and shall be only of such length, depth and width for making the particular type of joints. The bottom of the trench shall be rounded so that at least the bottom one-third of the pipe shall rest on undisturbed earth for the full length of the barrel as jointing operations will permit. This part of the excavation shall be done manually only a few feet in advance of the pipe laying by workmen skilled in this type of work.
- D. The sides of all trenches and excavation for structures shall be held by stay bracing, or by skeleton or solid sheeting and bracing according to conditions encountered, to protect the excavation, adjoining property and for the safety of personnel. Bracing and shoring may be removed when the level of the backfilling has reached the elevation to protect the pipe work and adjacent property. When sheeting or shoring above this level cannot be safely removed, it may be left in place. Timber left in place shall be cut off at least 2 feet below the surface. No sheeting below the level of the top of the pipe may be removed.

1.6 Dewatering and Protection Against Water:

- A. The Contractor shall remove water from the site and shall lower the ground water level as necessary to complete the excavations to the required depths and so that all required work can be accomplished in the dry. The Contractor shall do such well construction, well pointing, sheeting, ditching, and pumping, and shall construct necessary drains, channels

and sumps to keep his excavations and new structures clear of ground water, storm water or sewage and to keep his construction areas dry during the progress of the Work.

- B. Adequate measures and protection shall be provided by the Contractor to protect his work from damage from uplift due to ground water, storm water, or flood water. Any damages which may result shall be the Contractor's responsibility. The Contractor shall accept all responsibility for damage to the work of this Contract because of floods and water pressures and other water damages and shall accept all risks of floods and other events which may occur.
- C. All water discharged by pumping operations shall be discharged so as not to interfere with work under this Contract or with existing structures and operations. Water from dewatering operations shall be conveyed to the existing drainage features, using piping and pumping facilities provided by the Contractor. Route of dewatering pipe shall be subject to the Architect's review. Discharge facilities and water quality shall comply with applicable regulations of State and Federal agencies.
- D. Dewatering operations shall be uninterrupted and continuous during the course of the work so as not to endanger any construction in place or to present a hazard to workmen in and around the site. The Contractor shall take all measures necessary including, but not limited to, standby equipment and constant attendance to insure that the dewatering system remains operational and effective throughout the period of time that it is required.
- E. No water from dewatering operations shall be allowed to run over any uncompleted portions of the work. No units of the work shall be constructed under water. The cost of dewatering shall be included in the price bid for the item of work for which it is required.

1.7 Piling Excavated Materials:

- A. All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing roadways.

1.8 Limit to Length of Open Trench:

- A. The routine of operation shall be so organized to keep the length of open trench to a practicable minimum.

1.9 Removal of Unsuitable Material:

- A. Should overdepth excavation be necessary to remove unsuitable material and to replace with satisfactory material, the Contractor will be paid for this work based on the following requirements:
 - 1. Unsuitable materials for filling and backfilling are those classified as MH, CH, OL, OH and PT in accordance with the Unified Soil Classification System. Excavated soils that are too wet to compact shall not be classified unsuitable due to high moisture content alone.

2. When the trench is excavated to the plan depth or as required by these Specifications, and soft or other material not suitable for bedding purposes is encountered in the trench, the Contractor shall immediately notify the Architect for inspection and measurement of the unsuitable material to be removed.
3. No overdepth excavation or backfilling of the overdepth excavated trench shall start until proper measurements of the trench have been taken by the Architect for the determination of the quantity in cubic yards of unsuitable material excavated. Backfill material and backfilling shall conform to the requirements specified in Paragraph 12 below.
4. No payment will be made for any overdepth excavation of soft unsuitable material due to the failure of the Contractor to provide adequate means to keep the trench dry.
5. No payment will be made for any overdepth excavation of the unsuitable material and replacement not inspected and measured by the Architect prior to excavation.

1.10 Bedding of Concrete, Ductile Iron or Steel Pipe:

A. Pipe shall be laid on foundations prepared in accordance with ASTM C12 as modified herein, and in accordance with the various classes of bedding required by the trench width and trench depth for the size of pipe to be laid. Bedding shall be included in the appropriate unit price bid for clay, concrete, ductile iron or steel pipe.

1. Class "A" Bedding: Class "A" Bedding shall be achieved as follows:
 - a. The pipe shall be bedded in a monolithic cradle of plain or reinforced concrete having a minimum thickness under the pipe barrel of one-fourth the inside diameter of the pipe but in no case less than 4 inches and extending up the sides to a height of at least one-fourth of the pipe outside diameter. The cradle shall have a width equal to the full width of the trench as excavated. The pipe shall be laid to line and grade on concrete blocking after which the concrete shall be placed to the limits described. Concrete shall be 3,000 psi concrete.
2. Class "B" Bedding: Class "B" Bedding shall be achieved as follows:
 - a. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The crushed stone bedding shall have a minimum thickness of 6" below bottom of pipe and shall extend halfway up the pipe barrel at the sides. The remainder of the side fills and a minimum depth of 12 inches over the top of the pipe shall be filled with carefully compacted material. Where the Architect directs the use of crushed stone bedding, the bedding shall be Class "B" bedding.
3. Class "C" Bedding: Class "C" Bedding shall be achieved as follows:
 - a. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The granular bedding shall have a minimum thickness of 6

inches under the barrel and shall extend 1/4 of the outside diameter up the pipe barrel at the sides. The remainder of the side fills and to a minimum depth of 12 inches over the top of the pipe shall be filled with compacted backfill. Class "C" Bedding shall be used except where the Architect directs the use of crushed stone bedding.

4. Class "D" Bedding: Class "D" Bedding is achieved by shaping bell holes only on a flat trench and no care is taken to secure compaction at the sides and immediately over the pipe. This type bedding is not permitted.
5. Bell Holes: Bell holes shall be provided in all classes of bedding to relieve pipe bells of all load, but shall be small enough to insure that support is provided throughout the length of the pipe barrel.
6. Coarse Granular Bedding: Coarse Granular Bedding material shall consist of crushed stone or pea gravel, clean and graded, 95 to 100 percent of which shall pass a 3/4 inch sieve with 95 to 100 percent retained on a No. 4 sieve. Bedding material shall be placed on a flat bottom trench and thoroughly compacted by tamping or slicing with a flat blade shovel. Compacted bedding material shall be extended up the sides of the pipe to the heights shown for the various classes of bedding.
7. Overwidth Excavation: If trenches are excavated to widths in excess of those specified below, or if trench walls collapse, pipe shall be laid in accordance with the requirements for at least the next better class of bedding at the expense of the Contractor.
8. Borrow Backfill: Borrow backfill will be required if there is not sufficient suitable material available from other parts of the work to backfill the trenches. Borrow backfill from approved borrow pits shall be used. Only those soils in the borrow pits that meet the specified requirements for suitable material shall be used.
9. Trench Widths: Trench widths at the top of the pipe and depths for clay, concrete and metal pipes using the various bedding classes, shall not exceed those shown below:

Ductile Iron, Concrete, or Steel Pipe

Pipe Size	Maximum Trench Width	MAXIMUM TRENCH DEPTH			
		Class D Bedding	Class C Bedding	Class B Bedding	Class A Bedding
6"	2'-6"	0	14'	20'	30'
8"	2'-6"	0	14'	20'	30'
10"	2'-6"	0	14'	22'	30'
12"	2'-8"	0	14'	22'	30'

15"	3'-0"	0	14'	22'	30'
21"	3'-6"	0	14'	22'	30'
24"	4'-0"	0	14'	22'	30'

1.11 Bedding of PVC Pipe:

- A. Pipe shall be bedded true to line and grade with uniform and continuous support from a firm base in accordance with ASTM D2321 as modified herein. Blocking shall not be used to bring the pipe to grade. Bedding material shall be included in the unit price for plastic and FRP pipes.
- B. Embedment materials listed here include a number of processed materials plus the soil types defined by the USCS Soil Classification Systems in ASTM D2487. These materials are grouped into categories according to their suitability for this application:
 - 1. Class I: Angular 6 to 40 mm (1/4 to 1-1/2 inches), graded stone including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
 - 2. Class II: Coarse sands and gravels with maximum particle size of 40 mm (1-1/2 inches), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.
 - 3. Class III: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.
 - 4. Class IV: Silt, silty clays and clays including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class. These materials are not to be used for bedding, haunching or initial backfill.
 - 5. Class V: This class includes the organic soils OL, Oh and PT as well as soils containing frozen earth, debris, rocks larger than 40 mm (1-1/2 inches) in diameter, and other foreign materials. These materials shall not be used for bedding, haunching and initial backfill.
- C. Compaction of foundation, bedding, haunching and initial backfill shall extend to the trench wall.
- D. Embedment material in the area around the pipe shall be installed with care. Care shall be used to insure that sufficient material has been worked under the haunch of the pipe to provide adequate side support. Precautions must be taken to prevent movement of the pipe during placing of the material through the pipe haunch. Place initial backfill material in three stages: First, to the center line of the pipe; second, to the top of the pipe, and third, to a point 12 inches above the top of the pipe. Compact each stage of haunching and initial backfill by hand or mechanical tamping to a minimum of 90 percent

Standard Proctor Density. Where unstable trench walls exist because of migratory materials such as waterbearing silts or fine sands, care shall be taken to prevent the loss of side support through the migratory action.

- E. Avoid contact between the pipe and compaction equipment. Compaction of haunching, initial backfill and backfill material shall be done in such a way so that compaction equipment will not have a damaging effect on the pipe.
- F. Trench depths, using the various bedding classes, shall not exceed those shown below:

MAXIMUM TRENCH DEPTH

Pipe Size	Class IV Bedding	Class III Bedding	Class I or Class II Bedding
All Sizes	Not to be used	16'	30'

- 1. Density (Standard Proctor) of 95 percent minimum in pipe zone.

- G. ASTM D2321 "Underground Installation of Flexible Thermoplastic Sewer Pipe" shall be used in conjunction with the above.

1.12 Backfilling:

- A. Backfilling consists of placing suitable materials removed during the excavation into the excavated areas, placing embedment materials and compacting the same to a density equal to or greater than what exists before excavation or as specified herein.
- B. Under backfilling operations is also included removal of excess materials and debris from the site, leveling all depressions caused by operation of equipment and maintaining the backfilled areas until accepted by the Owner.
- C. All backfill material shall be free of stones, concrete and clay lumps larger than 1/3 cubic foot. Roots, stumps and rubbish which will decompose will not be permitted in the backfill. Backfill material shall have its moisture content corrected, as may be necessary before being placed in the trench to bring the moisture content to approximately "optimum" for good compaction. Any rock, stone, concrete, clay lumps larger than 1/3 cubic foot in volume, rubbish and debris shall be removed from the site and disposed of by the Contractor in a lawful manner.
- D. Backfilling operations in this work are referred to herein as Backfilling at the Pipe Zone, Type "A" and Type "B".
- E. Backfilling in the excavated areas below parts of proposed structures shall be referred to hereinafter as Type "A" Backfilling.
- F. Where trenches cross or extend under structures or into present roadways, future roadways or parking areas as shown on the Plans, the backfilling shall be referred to hereinafter as Type "A" Backfilling.
- G. Backfilling in all other areas shall be referred to hereinafter as Type "B" Backfilling.

H. Backfilling at the Pipe Zone.

1. Throughout the entire construction, backfilling at the pipe zone shall include bedding and shall be as follows: Backfill material shall be placed below, around each side, and over the top of the pipe, in approximately horizontal layers to a height of 12 inches over the top of the pipe. Layers shall be of such thickness to facilitate the required compaction. This backfill shall be well compacted by using mechanical tamping equipment in such manner as not to damage the pipe, pipe joints or shift the pipe alignment. Workmen shall not be permitted to walk over the pipe until at least 12 inches of compacted fill has been placed over the pipe. The Contractor shall not use water to obtain compaction except for adding water to the backfill material before placing in the trench to bring the moisture content to approximately "optimum" for good compaction.

I. Type "A" Backfilling.

1. Type "A" Backfilling consists of placing sand and gravel or other suitable materials excavated from the trench in the trench in 6 inch thick layers from a point 12 inches above the top of the pipe and mechanically tamped or compacted by rolling until the backfill density after compaction is equal to 98 percent of the maximum density obtainable at optimum moisture content as determined by the Standard Proctor Test (ASTM D698). No water shall be used to secure compaction except for adding water to the backfill material before placing in the trench to bring moisture content to approximately "optimum" for good compaction. Each 6 inch thick layer shall be mechanically tamped before additional backfill material is placed in the excavated area.

J. Type "B" Backfilling.

1. Type "B" Backfilling consists of placing sand and gravel or other suitable material excavated from the trench in the trench in 12 inch thick compacted layers from a point 12 inches above the top of the pipe. Each 12 inch thick layer shall be compacted before additional backfill material is placed in the excavation. Only mechanical tamping, use of roller or small tractor will be allowed. The density of the backfilled material after compaction shall be equal to 95 percent of the maximum density obtainable at optimum moisture content as determined by the Standard Proctor Test (ASTM D698). Except in the upper 12 inches, water shall be added to backfill material only before being placed in the trench in order to bring the moisture content to approximately "optimum" for good compaction.

1.13 Protection of Water Supply Pipes:

- A. Horizontal Separation: Sewers and force mains shall be laid at least 10 feet horizontally from any existing or proposed watermain. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot separation, such deviation may allow installation of the sewer or force main closer to a watermain, provided that the watermain is in a separate trench or on an undisturbed earth shelf located on the side of

the sewer or force main and at an elevation so the bottom of the watermain is at least 18 inches above the top of the sewer or force main.

- B. Crossings: Sewers and force mains crossing watermains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the watermain and the outside of the sewer or force main. This shall be the case where the watermain is either above or below the sewer or force main. The crossing shall be arranged so that the sewer or force main joints will be equidistant and as far as possible from the watermain joints. Where a watermain crosses under a sewer or force main, adequate structural support shall be provided for the sewer or force main to prevent damage to the watermain.
- C. Special Conditions: When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer or force main shall be constructed equal to water pipe in accordance with MWA Standards, and shall be pressure tested to assure watertightness prior to backfilling.

1.14 Utility Construction in Other Excavation:

- A. Where utilities are required to be constructed in areas also requiring excavation and backfill for other work, coordinate the work so that the parts come together properly and the construction of the various parts can be done without damage to other parts. Place bedding which will form bearing for pipes, using suitable material and shaping to the lower 1/3 of the pipe to provide uniform and continuous bearing. Compaction of backfill material which will form bearing shall be equal to that specified hereinbefore under Type "A" Backfilling. After the pipe or other utility is placed, backfilling shall proceed as specified hereinbefore following the requirements specified under "Backfilling at the Pipe Zone, " Type 'A' Backfilling", and "Type 'B' Backfilling" as applicable.

1.15 Testing:

- A. General: The Owner shall select a qualified independent testing laboratory for the purpose of identifying soils, checking densities, and classifying soils materials during construction.
- B. Moisture-Density Tests: Testing shall be in accordance with ASTM Methods D698 and D1557. A test shall be performed on each type of material used in the work regardless of source. Tests will be accompanied by particle-size analyses of the soils tested (ASTM Methods D421 and D422). Changes in color, gradation, plasticity or source of fill material will require the performance of additional tests. Copies of all test results shall be furnished to the Architect.
- C. Field Density Tests:
 - 1. Tests shall be made in accordance with ASTM Method D1556. Tests shall be made in accordance with the following minimum schedule or as required by the soils technician or as may be directed by the Architect:
 - 2. One test for each lift of backfill for each 200 feet of trench or fraction thereof.

D. Submittals:

1. The soils technicians will submit formal reports of all compaction tests and retests. The reports are to be furnished to the Owner and the Architect as soon as possible upon completion of the required tests.
2. This report information is to include but not be limited to the following:
 - a. Date of the test and date submitted.
 - b. Location of test.
 - c. Wet weight, moisture content and dry weight of field sample.
 - d. Description of soil.
 - e. Maximum dry density and moisture content of the lab sample which best matches the field sample in color, texture, grain size and maximum dry density.
 - f. Ratio of field dry density to maximum lab dry density expressed as a percentage.
 - g. Comments concerning the field density passing or failing the specified compaction.
 - h. Comments about recompaction if required.

E. Compaction Results.

1. If any compaction test reveals that fill or backfill is not compacted as specified, the Contractor shall scarify and recompact as required to achieve the specified density. Additional compaction tests shall be made to verify proper compaction. These additional tests, required due to failure of the original test, shall be paid for by the Contractor without reimbursement by the Owner.
2. The soils technician is to advise the Architect and the Contractor's Superintendent immediately of any compaction tests failing to meet the specified minimum requirements. No additional lift is to be placed on a lift with any portion failing.

1.16 Construction Along Highways, Streets and Roadways:

- A. Excavation, Trenching and Backfilling Operations: Excavation, trenching and backfilling along highways, streets and roadways shall be in accordance with the applicable regulations of the governing jurisdiction with reference to construction operations, safety, traffic control, road maintenance and repair.
- B. Protection of Traffic: Provide suitable signs, barricades and lights for protection of traffic, in locations where traffic may be endangered by construction operations. All signs removed by reason of construction shall be replaced as soon as condition which

necessitated such removal has been cleared. No highway, street or roadway shall be closed without first obtaining permission from the proper authorities.

C. Construction Operations: The Contractor shall construct all work along highways, streets and roadways using the following sequence of construction operations, so as to least interfere with traffic:

1. Stripping: Where the pipe line is laid along roadshoulders, sod, topsoil and other material suitable for shoulder restoration shall be stripped and stockpiled for replacement.
2. Trenching, Laying and Backfilling: Excavate trenches, install pipe line and backfill. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying operations. Trenches shall be progressively backfilled and consolidated and excess material removed immediately.
3. Shaping: Immediately after completing backfilling operations, re-shape any damage to cut and fill slopes, side ditch lines, and replace topsoil, sod and any other materials removed from shoulders.

D. Excavated Material: Excavated material shall not be placed along highways, streets, and roadways in such manner as to obstruct traffic. Roadways and pavement will be maintained free of earth material and debris.

E. Drainage Structures: All side ditches, culverts, cross drains and other drainage structures shall be kept clear of excavated material and be free to drain at all times.

F. Maintaining Highways, Street, Roadways and Driveways:

4. 1. The Contractor shall furnish a road grader which shall be available for use at all times for maintaining highways, streets and roadways which shall be maintained in suitable condition until completion and final acceptance of the work.
5. 2. Repair all driveways that are cut or damaged. Maintain them in suitable condition until completion and final acceptance of the work.

1.17 Removing and Resetting Fences:

A. Where existing fences must be removed to permit construction, the Contractor shall remove such fences. As construction progresses, reset the fences in their original location and to their original condition. All costs of removing and resetting fences and such temporary works as may be required shall be included in the prices for the utility line.

1.18 Protecting Trees, Shrubbery and Lawns:

A. Trees and shrubbery along trench lines shall not be disturbed unless absolutely necessary. Trees and shrubbery necessary to be removed shall be properly heeled-in and re-planted.

Heeling-in and re-planting shall be done under the direction of an experienced nurseryman.

- B. Where utility trenches cross established lawns, sod shall be cut, removed, stacked and maintained in suitable condition until replaced. Topsoil underlying lawn areas shall likewise be removed and kept separate from general excavated materials. Removal and replacement of sod shall be done under the direction of an experienced nurseryman.

1.19 Remove and Replace Pavement:

- A. Pavement and base course which must be removed for constructing sewers, manholes, forcemains, water lines, and all other appurtenances in streets shall be replaced as specified in Section 33 30 00 or 33 10 00.
- B. The top 18 inches of subgrade material immediately under the paving base and also road shoulder shall be carefully removed and kept separate from the rest of the excavated material. This material shall be placed in the top 18 inches of the backfill. Further compaction shall be accomplished by leaving the backfilled trench open to traffic while maintaining the surface with crushed stone or gravel. Settlement in trenches shall be refilled with crushed stone or gravel, and such maintenance shall continue until replacement of pavement.
- C. Where utility lines are constructed on unpaved streets, roads or easements, the top 18 inches of soil shall be stripped and windrowed separate from the excavation from trenches. After the line has been installed and the backfill completed within 18 inches of the original grade, the salvaged surfacing shall be replaced. This work shall be considered as general clean up along with the removal of surplus excavated materials from the site and the restoring of the surface outside trench limits to its original condition, the cost of which shall be included in the price bid for the utility line.

1.20 Walks, Drives, Concrete Curb and Gutter:

- A. Walks and drives removed or damaged during the course of construction shall be replaced with Class "A" concrete at the same thickness as removed. They will be cut to a neat edge with a masonry saw after backfilling and compacting trench in 6 inch layers to a density not less than 98 percent at + 2 percent of optimum moisture content as determined by the Standard proctor Test.
- B. Concrete curb and gutter sections removed or damaged during the course of construction shall be replaced in full sections with concrete having a compressive strength of at least 3,000 psi.

END OF SECTION 31 50 00

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

- A. Related Work: Drawings and general provisions of Contract, including General and Supplementary Conditions.
- B. Description of Work: Extent of asphalt concrete paving work is shown on the drawings. This work shall include the base and asphaltic concrete paving of the thicknesses and types shown on the drawings for the driveways. All work shall be in accordance with the Georgia Department of Transportation's standards and specifications. Discrepancies between these specifications and the Georgia D.O.T Specifications shall be resolved in favor of the requirements of the Georgia D.O.T. Specifications, latest edition.
- C. Submittals: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.
- D. Related Section: Section 32 17 23, Pavement Markings.
- E. Job Conditions: Base course may be placed when air temperature is above 30 F (-1 C) and rising.
 - 1. Grade Control: Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

- A. Materials:
 - 1. General: Use locally available materials and gradations which exhibit a satisfactory record of previous installations. All materials shall meet Department of Transportation Specifications.
 - 2. Base Course: Base material shall be in accordance with the details shown on the drawings.
 - 3. Asphalt Cement: AASHTO M 226 (ASTM D 3381) for viscosity-graded material and AASHTO M 20 (ASTM D 946) for penetration-graded material.
 - 4. Tack Coat: Tack coat shall conform to the Georgia Department of Transportation Specifications.
 - 5. Soil Sterilant: Soil Sterilant shall be Hybar or equal.
- B. Asphalt-Aggregate Mixture: Provide plant-mixed, hot-laid asphalt-aggregate mixture complying with Georgia Department of Transportation Standard Specification Section 400.

PART 3 - EXECUTION

- A. Surface Preparation: Compact base course to 100% of its maximum dry density as determined by Modified Proctor ASTM D 1557. Sterilize soil following manufacturer's recommendations. Remove loose material from compacted base surface immediately before applying prime coat. Proof roll prepared base surface to check for unstable areas and areas requiring additional compaction.

Notify Architect of unsatisfactory conditions. Do not begin paving work until deficient base areas have been corrected and are ready to receive paving.

1. Prime Coat: Apply at rate of 0.20 to 0.25 gal. per sq. yd., over compacted base. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

B. Placing Mix:

1. Base Course: Place base course on a prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Placement of base material shall conform to Georgia D.O.T. standards.
2. Asphaltic Concrete:
 - a. General: Place asphalt concrete mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 225° F (107° C). Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness as shown on the drawings.
3. Paver Placing: Place in strips not less than 10' wide, unless otherwise acceptable to Architect. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.
4. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density and smoothness as other sections of asphalt concrete course.

C. Rolling:

1. General: Begin rolling when mixture will bear roller weight without excessive displacement.

The layers shall be rolled to produce a minimum density equivalent to 95 percent of the laboratory design density, as determined by the Marshall Stability test method and obtain a minimum Marshall stability value of 1,500 pounds.

Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

2. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.
3. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
4. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
5. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.
6. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
7. Erect barricades: to protect paving from traffic until mixture has cooled enough not to become marked.

D. Pavement Markings:

1. Cleaning: Sweep and clean surface to eliminate material and dust.
2. Do not apply lane markings until layout and placement has been verified with Architect.
3. See Drawings for areas to be Thermoplastic Striping.

E. Field Quality Control:

1. General: Testing company shall test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Architect. Two tests shall be performed in Typical Asphalt Paving and two tests for Heavy Duty Asphalt Paving.

Testing company shall perform a minimum of 4 asphalt core test at locations directed by Architect. Two tests shall be performed in Typical Asphalt Paving and two tests shall be performed in Heavy Duty Asphalt Paving.

2. Thickness: In-place compacted thickness will not be accepted if exceeding following allowable variation from required thickness:

Base Course: ½”
Binder & Surface Course” ¼”

3. Surface Smoothness: Test finished surface of each asphalt concrete course for smoothness, using 10’ straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be accepted if exceeding the following tolerances for smoothness.
Wearing Course Surface: 3/16”
Check surface areas at intervals as directed by Architect.
4. Correcting Deficient Paving: If test results determine that the average thickness of base of binder and surface course exceeds the allowable variation, the Contractor shall resurface the entire paving area with surface course materials at no expense to the Owner. The minimum thickness for asphaltic resurfacing shall be in inch.

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

- A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions.
- B. Description of Work:
 - 1. Extent of concrete curbs and concrete paving and walks are shown on the drawings.
 - 2. Prepared subbase is specified in "Earth Moving" section.
 - 3. Concrete and related materials are specified herein.
- C. Quality Assurance:
 - 1. Codes and Standards: All work and materials shall conform to Georgia Department of Transportation's Specifications, 1993 Edition.
- D. Submittals: Furnish samples, manufacturer's product data, test reports, and materials' certifications as required in referenced sections for concrete.
- E. Job Conditions:
 - 1. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 - PRODUCTS

- A. Materials:
 - 1. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.

Use flexible spring steel forms or laminated boards to form radius bends as required.

Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.
- B. Concrete Mix, Design and Testing: Design mix to product normal-weight concrete consisting of Portland cement, aggregate, air-entraining admixture and water to produce the following properties:

Compressive Strength: 3000 psi minimum – Walls, Walkways Curb & Gutter

Compressive strength shown above is required minimum at 28 days, unless otherwise noted.

Slump Range: 3" for all concrete.

Air Content: 5% to 8%.

PART 3 - EXECUTION

- A. Surface Preparation: Remove loose material from compacted subbase surface immediately before placing concrete.

Proof-roll prepared subbase surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and area ready to receive paving.

- B. Form Construction: Set forms to required grades and lines with gutter pitched to drain in locations indicated by the grades shown on the plans. Rigidly brace and secure all forms. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

Check completed formwork for grade and alignment to following tolerances:

Top of forms not more than 1/8" in 10'.

Vertical face on longitudinal axis, not more than 1/4" in 10'.

Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

- C. Concrete Placement:

1. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

2. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of joint devices.

Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2-hour, place a

construction joint.

3. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimum specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

D. Joints:

1. General: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.

When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.

2. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints at 15 feet on center. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, as follows:
3. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
4. Inserts: Use embedded strips of metal or sealed wood to form weakened-plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.
5. Construction Joints: Place construction joints at end of placements and at locations when placement operations are stopped for a period of more than 1/2-hour, and at every third contraction joint.

Construct joints as shown or, if not shown, use standard metal keyway-section forms.

Where load transfer-slip dowel devices are used, install so that one end of each dowel bar is free to move.

6. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks and other fixed objects, unless otherwise indicated.

- E. Concrete Finishing: After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2" radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Architects.

F. Repairs and Protections:

1. Repair or replace broken or defective concrete, as directed by Architect.
2. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

Sweep concrete curb and gutter and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

END OF SECTION 32 13 13

SECTION 321416.13 – BRICK UNIT PAVING – UNGROUTED

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. Brick pavers set in aggregate setting beds.
 - 2. Steel edge restraints.
 - 3. Cast-in-place concrete edge restraints.

1.3 SUBMITTALS

- A. Section Cross Reference: Refer to Division 01 Submittals Section for general requirements.
- B. Product Data: For the following, for information only: Include technical data and tested physical and performance properties.
 - 1. Pavers.
 - 2. Edge restraints.
- C. Sieve Analyses: For aggregate setting-bed materials, joint sand and bituminous setting bed aggregate according to ASTM C 136.
- D. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of unit paver indicated.
- E. Samples for Verification: Full-size units of each type of unit paver indicated, in sets for each color, texture, and pattern specified, showing full range of variations expected in these characteristics.
- F. Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.
- G. Installer Certification: Submit written documentation that Installer complies with requirements of "Installer Qualifications". Include lists of completed projects with project names and addresses, and other information specified.

1.4 QUALITY ASSURANCE

- A. Industry Reference Standards: Refer to Division 1 References Section
 - 1. Brick Industry Association (BIA): Technical notes on brick construction, latest edition.
- B. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.
- C. Qualifications:
 - 1. Installer Qualifications: Engage a firm specializing in brick unit paver installation. Installer shall have successfully completed at least ten (10) brick unit paver installation projects of the same materials, design and of similar size and scope of work to that indicated for this Project.
 - 2. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of State in which project is located.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Field Constructed Mock-Up: Prior to installing brick unit pavers, furnish and install a 100 square foot sample of pavement for each form and pattern of pavement indicated with proposed materials, and workmanship to be expected in completed work. Build mock-ups to comply with the following requirements: using materials, same base construction, joints and edges as indicated for final unit of Work.
 - 1. Locate mock-ups on site in the location and of the size indicated; or if not indicated, as directed by Landscape Architect.
 - 2. Obtain Landscape Architect's acceptance of mock-ups before start of the final unit of Work.
 - 3. Replace unsatisfactory mock-up work, as directed, until acceptable by Landscape Architect.
 - 4. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging the completed unit of Work. Do not alter, move, or destroy mock-up until work is completed. The approved sample in undisturbed condition at Date of Substantial Completion may become part of completed unit of Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers 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.
- B. Store liquids in tightly closed containers protected from freezing.

1.6 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.

PART 2 - PRODUCTS

2.1 BRICK PAVERS

- A. Regional Materials: Provide brick pavers that have been manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- B. Brick Pavers: Per construction drawings material finish schedule.
- C. Efflorescence: Brick shall be rated "not effloresced" when tested according to ASTM C 67.
- D. Temporary Protective Coating: Precoat exposed surfaces of brick pavers with a continuous film of a temporary protective coating that is compatible with brick, mortar, and grout products and can be removed without damaging grout or brick. Do not coat unexposed brick surfaces; handle brick to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

2.2 CURBS AND EDGE RESTRAINTS

- A. Steel Edge Restraints: Manufacturer's standard painted steel edging 3/16 inch (4.8 mm) thick by 4 inches (100 mm) high with loops pressed from or welded to face to receive stakes at 36 inches (900 mm) o.c., and steel stakes 15 inches (380 mm) long for each loop.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Border Concepts, Inc.
 - 2. Color: As selected by Landscape Architect from manufacturer's full range.
- B. Job-Built Concrete Edge Restraints: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi (20 MPa).

2.3 AGGREGATE SETTING BED MATERIALS:

- A. Aggregate for Compacted Base: Quality controlled, graded crushed stone complying with ASTM D 2940 for base material.

- B. Sand for Bedding/ Leveling Course: Sound sharp, symmetrically shaped, non-plastic aggregate free from deleterious or foreign matter. The aggregate shall be natural sand or manufactured from crushed stone. Particles shall conform to grading requirements of ASTM C 33, for fine aggregate. Do not use mason sand, or sand conforming to ASTM C144.
- C. Sand for Joints: Fine, sharp, washed, natural sand or manufactured from crushed stone with one hundred percent (100%) passing No. 16 (1.18-mm) sieve and no more than ten percent (10%) passing No. 200 (0.075-mm) sieve. Do not use mason sand.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and waterproofing protection is in place.

3.2 PREPARATION

- A. Subgrade Preparation: Excavate and compact soil subgrade. Compact soil to not less than 95 percent maximum dry unit weight as determined in accordance with ASTM D 698.
- B. Proof roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction. Do not proceed with installation of unit pavers until deficient subgrades have been corrected and are ready to receive subbase for unit pavers.

3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

- E. Joint Pattern: As indicated.
- F. Bituminous Setting-Bed Thickness: Setting bed thickness should be established so that when the pavers are fully set on adhesive layer, finished surface will be approximately 1/8 inch (3.1 mm) above required grades.
- G. Tolerances: Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.
- H. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
 - 1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
 - 2. Install job-built concrete edge restraints to comply with requirements in Division 03 Section "Cast-in-Place Concrete."
 - 3. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.
 - 4. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.

3.4 AGGREGATE SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.
- B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least 12 inches (300 mm).
- D. Place aggregate base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.
- E. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- F. Treat leveling course with herbicide to inhibit growth of grass and weeds.
- G. Set pavers with a minimum joint width of 1/16 inch (1.5 mm) and a maximum of 1/8 inch (3 mm), being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed [3/8 inch (10 mm)] <Insert dimension> with pieces cut to fit from full-size unit pavers.

1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- H. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches (900 mm) of uncompacted pavers adjacent to temporary edges.
 2. Before ending each day's work, compact installed concrete pavers except for 36-inch (900 mm) width of uncompacted pavers adjacent to temporary edges (laying faces).
 3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches (90 mm) of laying face.
 4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.
- I. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- J. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- K. Where joint sand stabilizer is used, completely sweep surface to remove all excess sand and residue. Surfaces must be free of stabilizer product. Wet surface and joint sand per manufacturer's instructions. Allow for drying and restrict use per manufacturer's instructions.
- L. Repeat joint-filling process 30 days later.

3.5 REPAIRING AND CLEANING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.
- B. Cleaning:
1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver manufacturers.
 2. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.
- C. Provide final protection and maintain conditions in a manner acceptable to Installer, which ensures unit paver work being without damage or deterioration at Date of Substantial Completion.

END OF SECTION 321416.13

SECTION 32 17 23 - PAVEMENT MARKING

PART 1 - GENERAL

1.1 Summary:

- A. This Section includes markings of pavement and curbs, including parking bay striping, lane divider stripes, directional arrows, fire lanes, handicapped parking, and any other information markings required for a certificate of occupancy.
- B. Refer to SECTION 32 12 16 – Asphalt Paving

1.2 Submittals:

- A. Product Data: Manufacturer's specifications and technical data.

1.5 Job Conditions:

- A. Inspection:
 - 1. Examine areas for conditions under which work is to be performed. Report in writing to Owner all conditions contrary to those shown on the drawings or specified herein and all other conditions that will affect satisfactory execution of work such as improperly constructed substrates or adjoining work. Do not proceed with work until unsatisfactory conditions have been corrected.
 - 2. Starting work constitutes acceptance of the conditions under which work is to be performed. After such acceptance this contractor shall, at his expense, be responsible for correcting all unsatisfactory and defective work resulting from such unsatisfactory conditions.

PART 2 - PRODUCTS

2.1 Materials:

- A. Paint: Colors conforming to specifications and standards of regulatory and transportation authorities having jurisdiction at Project site, including following referenced standard.
 - 1. Georgia Department of Transportation and the City of Warner Robins Engineering Department.
- B. Paint type for cured concrete surfaces, rubber-based type:
 - 1. Traffic Marking Paint is based on products manufactured by ENNIS PAINT CO., Ennis, TX.

2. Product information is listed for reference purposes to establish material characteristics, quality, and finish. Alternate manufacturer's products shall meet or exceed the listed products. Other acceptable manufacturers include:
 - a. STIMSONITE CORP., Atlanta, GA
 - b. CROWN TECHNOLOGY, INC., LaGrange, GA
- C. ARK-LA-LINE type asphaltic concrete surface paint or equal (meeting Ga. Dept. of Transportation Standards).
 1. Product information is listed for reference purposes to establish material characteristics, quality, and finish. Acceptable manufacturers include:
 - a. ENNIS PAINT CO., Ennis, TX
 - b. STIMSONITE CORP., Atlanta, GA
 - c. CROWN TECHNOLOGY, INC., LaGrange, GA

PART 3 - EXECUTION

3.1 Preparation:

- A. Remove all dirt, oil, grease and other foreign material from areas of pavement to be marked.
- B. Apply paint only on thoroughly dry surfaces, when atmospheric temperature is above 40 degrees Fahrenheit and when weather is favorable.

3.2 Installation:

- A. Apply respective markings in colors in accordance with standards of regulatory and transportation authorities having jurisdiction at Project site, including following referenced: Standards and Specifications of the City of Macon Engineering Department and the Georgia Department of Transportation.
- B. Apply with a coverage rate of 100 to 110 square feet per gallon with 0.015 inch film thickness.
- C. Do not permit traffic on pavement until markings are thoroughly dry.

END OF SECTION 32 17 23

SECTION 328410 - PLANTING IRRIGATION - PERFORMANCE SPECIFICATION

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. Piping.
2. Manual valves.
3. Pressure-reducing valves.
4. Automatic control valves.
5. Automatic drain valves.
6. Transition fittings.
7. Dielectric fittings.
8. Miscellaneous piping specialties.
9. Sprinklers.
10. Quick couplers.
11. Drip irrigation specialties.
12. Controllers.
13. Boxes for automatic control valves.

- B. The limits of the area to be irrigated by an underground irrigation system is shown on the Drawings. The Drawings to not depict the irrigation design.

- C. Provide all labor, materials and equipment required by or inferred from the Drawings and Specifications to complete the Work of this Section.

1. Provide and complete an operable system for the irrigation of all landscaped areas indicated, on the project site. The Drawings and specifications are intended to provide a guideline for all items deemed necessary and requisite for the proper irrigation of the Project.
2. The Contractor shall be responsible for adjusting head location, head/nozzle type and size, and any other system components so that irrigation system layout is coordinated with actual field conditions. Such adjustments shall be made at no cost to the Owner except, when authorized in writing, such adjustments which will be compensated for at an agreed upon cost.

- D. Provide additional work and materials required by local authorities at no extra cost to Owner.

1.3 DEFINITIONS

- A. Supply Piping: Piping from water source to connection to irrigation system pressure piping. Piping is under same pressure as water supply.
- B. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- C. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- D. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- E. Control Valve: Manual or automatic (electrically operated) valve to control water flow to irrigation system zone.
- F. Drain Valve: Manual or automatic (pressure operated) drain valve for draining downstream from circuit piping drain valves. Piping is not under pressure.
- G. 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.
- H. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile – butadiene – styrene plastic.
 - 2. NP: Nylon plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PTFE: Polytetrafluoroethylene plastic.
 - 5. PVC: Polyvinylchloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. The Drawings are diagrammatic and indicate the limits of the irrigation Work to be installed. The Drawings do not depict the irrigation design and sleeves. The Contractor shall furnish such items as may be required to complete the work.
- B. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- C. Location of Sprinklers and Specialties: Make minor location adjustments, based on field conditions, necessary to avoid plantings and obstructions such as signs and light standards.
- D. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive design analysis by a qualified professional irrigation designer, using performance requirements and design criteria indicated.
- E. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise required in the final design. Indicate deviation from the following in the delegated-design shop drawings.

1. Irrigation Main Piping: 200 psig (1380 kPa).
2. Circuit Piping: 150 psig (1035 kPa).
3. Drain Piping: 100 psig (690kPA).

1.5 SUBMITTALS

- A. Approval: Obtain approval from Landscape Architect for all submittals prior to the beginning of Work, unless otherwise approved.
- B. Product Data: Submit for information only, manufacturer's specifications, product data, installation instructions and general recommendations for all components of the irrigation system. Individual copies of product data shall be submitted with the specific product name and model number visibly identified with specific product and model number being identified using a highlighter, asterisk or underlining.
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. 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 irrigation designer responsible for their preparation.
- E. Delegated-Design Shop Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.
- F. Qualification Data: Submit written documentation certifying that Installer complies with requirements of "Installer Qualifications".
- G. As-Built Drawings: Any changes in the layout and/or arrangements of the proposed irrigation system, or any other differences between the proposed system and actual installed conditions are to be recorded by the Irrigation Contractor in the form of an "As-Built" Drawing. As-Built Drawing shall be produced in an electronic format using AutoCAD. Provide the Owner and Landscape Architect an AutoCAD and PDF file along with five (5) hard copies of the As-Built Drawings before Work under this Contract will be considered for Acceptance. All automatic and manual valves, hose bibs or quick couplers, and wire splice locations shall be shown with actual dimensions in feet and inches from two reference points so they may be located easily in the field. Submittal of approved As-Built Drawings shall precede any Application for Final Payment by the Contractor.
- H. Operation and Maintenance Data: Submit for inclusion in Operation and Maintenance Manuals copies of Maintenance and Operation Data for the pump station which shall include calibration procedures, operating instructions, and maintenance instructions. Refer to Division 1 Operation and Maintenance Data for submittal requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:

1. Engage a firm or firms specializing in irrigation design and installation. Installer shall have successfully completed ten (10) projects similar in material, size, scope and complexity to that indicated for this Project that have resulted in construction with a record of successful in-service performance.
 - a. Design Responsibility: Installer shall engage a certified irrigation designer qualified by the American Society of Irrigation Consultants (ASIC) who is experienced in providing the design services of the kind indicated. The irrigation designer's stamp shall appear on the shop drawing submittals.
 - b. Firm Experience Period: Ten (10) years of experience.
 - c. Field Foreman Experience: Five (5) years of experience with installing firm.
 2. Fabricator Qualifications: Engage a firm specializing in pump station fabrications. Fabricator shall provide evidence to indicate successful completion of ten (10) projects similar in material and scope of work to that specified.
 - a. Design and Engineering Responsibility: Fabricator shall engage a professional engineer legally authorized to practice in the jurisdiction where the project is located. The professional engineer's stamp shall appear on shop drawings submittals including drawings and design calculations.
 - 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.
 - C. Codes and Standards: Perform the work in compliance with applicable requirements of governing authorities having jurisdiction. County regulations supersede these specifications. Notify Landscape Architect in writing of all discrepancies immediately.
 - D. Approval and Selection of Materials and Work: The selection of all materials and the execution of all operations required under the Specifications is subject to the approval of the Owner and Landscape Architect. They have the right to reject any and all materials and any and all Work which, in their opinion, does not meet the requirements of the Contract Documents at any state of the operations. Remove rejected Work and/or materials from project site and replace promptly.
 - E. Workmanship: Install materials and equipment in a neat and professional manner following manufacturer's recommendations.
- 1.7 MATERIAL QUANTITIES
- A. It is the Contractor's responsibility to total and confirm all material quantities.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials and equipment in such a manner as to not damage the parts or decrease the useful life of equipment.

- B. Store materials away from detrimental elements. Coordinate with Owner or General Contractor to secure a safe staging area. Security of stored materials shall be provided by the contractor at all times.
- C. Deliver piping 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.
- D. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.
- E. Handle, load, unload, stack and transport materials for irrigation system carefully to avoid damage. Handle pipe in accordance with manufacturer's recommendations.

1.9 PROJECT CONDITIONS

- A. The site irrigation system is comprised of three major components, a supply irrigation distribution, and sprinkler system. Do not order, procure or make deposits on related equipment until supply has been determined. The Contractor shall connect the distribution network to the domestic water meter. The Contractor will reimburse the Owner for all work deleted and not completed.
- B. Insurance on irrigation materials or equipment stored or installed is the responsibility of the Contractor. Such insurance shall cover fire, theft and vandalism. Should the Contractor elect not to provide for such insurance, he will in no way hold the Owner responsible for any losses incurred by the aforementioned acts. The Contractor is responsible for all costs incurred in replacing damaged or stolen materials or equipment prior to Substantial Completion of the Work.
- C. Obtain all required permits and pay all required fees, at no additional cost to the Owner. Any penalties imposed due to failure to obtain permits or pay fees are the responsibility of the Contractor.
- D. Provide and maintain all passageways, guard fences, warning lights and other protection devices required by the local authorities.
- E. Existing Grades: Existing grades will be within .2 feet of grades shown on the Civil Engineering Drawings at time of irrigation work. Determine conditions of existing grades prior to beginning the Work. When irregular or incomplete grading conditions are encountered, notify the Owner in writing before beginning the Work. Determine location of existing drainage patterns and maintain patterns in completed Work. Perform Work in a manner which will avoid damage to finished grading and drainage patterns. All damage to finished grading and drainage resulting from Work covered in these Contract Documents shall be repaired at the Contractor's expense.
- F. Existing Utilities: Determine location of underground utilities. Perform Work in a manner which will avoid possible damage. Excavate as required. Maintain grade stakes set by other unless removal is mutually agreed upon by parties concerned. All damage to utilities resulting from Work covered in these Contract Documents shall be repaired at the Contractor's expense.
- G. Existing Conditions: Perform irrigation Work in the Tree Protection zones and in existing or previously completed landscape areas to avoid damage and disturbance to these areas. Limit work in these areas to only that necessary to perform work specified herein and shown on the

Drawings. Return and repair any areas damaged or disturbed while performing the Work to the existing conditions encountered prior to the Work.

- H. Existing Site Improvements: Perform Work in a manner which will avoid possible damage to other work. The Contractor is responsible for any damage of mechanical nature as well as damage resulting from leaks in the irrigation system whether due to negligence or otherwise.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition at the Contractor's expense.
- I. Test Water Conditions: The Contractor shall check the pressure at the irrigation meter and confirm minimum operating pressure required by the delegated-design. If minimum operating pressure cannot be obtained, notify Landscape Architect.
 - 1. In the event the water pressure does not meet minimum operating pressure at the meter as required, notify the Owner and/or Landscape Architect, state conditions and submit a proposal to for installing a booster pump system capable of increasing the pressure to the minimum required.
 - 2. In the event the water pressure significantly exceeds the operating pressure required, provide a pressure regulator down stream of the backflow preventer.
- J. Coordinate and schedule all Work with General Contractor.
- K. Damages resulting from irrigation installation to work of other trades must be repaired at the expense of the Irrigation Contractor in a timely fashion.
- L. Make minor adjustments to system layout as may be required and requested at no additional cost to the Owner.
- M. Keep project site clean and orderly at all times during construction.

1.10 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. Impact Sprinklers: Equal to 10 percent of amount installed for each type and size indicated, but no fewer than 3 units.
 - 2. Spray Sprinklers: Equal to 10 percent of amount installed for each type and size indicated, but no fewer than 3 units.
 - 3. Bubblers: Equal to 10 percent of amount installed for each type indicated, but no fewer than 3 units.
 - 4. Emitters: Equal to 10 percent of amount installed for each type indicated, but no fewer than 3 units.
 - 5. Drip-Tube System Tubing: Equal to 10 percent of total length installed for each type and size indicated, but not less than 100 feet (30 m).
 - 6. Soaker Tubes: Equal to 10 percent of total length installed for each type and size indicated, but not less than 50 feet (15.2 m).

1.11 WARRANTY

- A. Warranty all Work for a period of one year, starting on the Date of Substantial Completion, against defects in materials, equipment, workmanship and any repairs required resulting from leaks or other defects of workmanship, material or equipment.
- B. Provide written warranty executed by pump station manufacturer that all system equipment and components will be free from all defects in material and workmanship for a period of one (1) year after the Date of Substantial Completion.
- C. Emergency repairs may be made by the Owner without relieving the Contractor of his warranty obligations.
- D. Repair settling of backfill trenches occurring during the warranty period, including restoration of damaged plantings, paving or improvements resulting from settling of trenches or repair operations.
- E. Respond to Owner's request for repair work within ten (10) days. If not, Owner may proceed with such necessary repairs at the Contractor's expense.

PART 2 - PRODUCTS

2.1 PIPES 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. Ductile-Iron Pipe with Mechanical Joints: AWWA C151, with mechanical-joint bell and spigot ends.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Ductile-Iron Pipe with Push-on Joint: AWWA C151, with push-on-joint bell and spigot ends.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
- D. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedule 80.
 - 1. PVC Socket Fittings: ASTM D 2466, Schedule 80.
- E. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21 of the following size and class

1. 3 inches and larger; Class 200.
 2. 2-1/2 inches to 3/4 inches; Class 200.
 3. 1/2 inch; Class 315.
 4. PVC Socket Fittings: ASTM D 2467, Schedule 80.
- F. Pipe three (3) inch and larger shall be PVC pipe with bell and rubber ring gasket, unless otherwise indicated.
- G. Pipe smaller than three (3) inches shall be solvent weld PVC pipe.
- H. Fittings for integral bell rubber ring gasketed pipe (three (3) inches and larger) shall have the gasket type fittings.
- I. All pipe fittings size three (3) inches and greater shall be ductile iron in construction. All fittings two and one-half (2 1/2) inches and under shall be Schedule 40 solvent weld fittings rated for 200 psi (ASTM D 3139).
- J. Solvent weld PVC pipe shall be rigid PVC pipe and shall be assembled using appropriate PVC pipe cleaner/primer and solvent cement in accordance with the manufacturer's recommendations. Solvent cement shall be No. 717 Gray NSF approved.
- K. All solvent weld firings shall conform to Schedule 40 or Schedule 80 PVC dimensions and specifications for solvent weld fittings.
- L. Expansion Joints: Shall consist of integral bell and rubber gasket coupling, install every three hundred (300) feet of solvent weld piping.
- M. Runs of pipe over twenty (20) feet in length must be installed with standard twenty (20) feet length sections.
- N. PVC Pipe Couplings located Within Sleeves: Four (4) inches and smaller shall be solvent weld. Six (6) inches and larger shall be mechanical joints. Upon exiting sleeves, pipe solvent weld or integral bell and rubber gasket, as specified.

2.2 RISERS

- A. Provide Threaded Schedule 80 PVC Risers. All risers above grade to be either dark gray or black PVC pipe.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) 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. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 ELECTRIC WIRING

- A. 120 Volt AC Wiring: 120 volt service to controller shall consist of three wires: one black, one white, and one ground. Electrical service to be provided by Contractor:
- B. Splices in controller wiring shall be waterproof.
- C. Control wiring shall be 600 volt wire U.L. approved for direct burial in ground. Minimum wire size: 14 gauge. Control wiring and wiring connections from the controller to the valves is included in this Contract.

2.5 MANUAL ISOLATION VALVES

- A. Bronze Gate Valves:
 - 1. Valves for isolation purposes shall be bronze manually operated gate valves, allowing full diameter opening when in the full open position of the same size as line.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. Class: 125.
 - c. CWP Rating: 200 psig (1380 kPa).
 - d. Body Material: ASTM B 62 bronze with integral seat and screw-in bonnet.
 - e. Ends: Threaded.
 - f. Stem: Bronze, nonrising.
 - g. Disc: Solid wedge; bronze.
 - h. Packing: Asbestos free.
 - i. Handwheel: Malleable iron, bronze, or aluminum.

2.6 PRESSURE-REDUCING VALVES

- A. Water Regulators:
 - 1. Description:
 - a. Standard: ASSE 1003.
 - b. Body Material: Bronze for NPS 2 (DN 50) and smaller; cast iron for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
 - c. Pressure Rating: Initial pressure of 150 psig (1035 kPa).
 - d. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

2.7 AUTOMATIC CONTROL VALVES

A. Plastic, Automatic Control Valves:

1. Description: Manufacturer's standard control valves for irrigation zones, of type and size indicated, and as follows: Valves are to be constructed of a glass filled nylon material with a self cleaning stainless steel screen. The control valve shall be considered to be a "contamination resistant style valve" with flow/low pressure operating capabilities. Flow .25 to 200 GPM; Pressure: 20 to 200 PSO. Valves to conform to Manufacturer's Specifications concerning performance and at pressure provided. Operation will occur through a 24-volt pulse to the AC solenoid.

2.8 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201, Sizes A to F.
- B. Pressure Gages: ASME B40.1. Include 4-1/2-inch- (115-mm-) diameter dial, dial range of two times system operating pressure, and bottom outlet.

2.9 SPRINKLERS

- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.
- B. Rotary Sprinkler Heads: The sprinkler shall be capable of covering a 25-40 foot radius at 30-70 psi with a distribution rate of 1.5-8.0 gpm, four (4) inch or twelve (12) inch pop-up trajectory of 13-25 degrees, matched precipitation rate nozzles, filter screen, reducible water radius. The body of the sprinkler shall have a three-quarter (3/4) inch female inlet and a factory installed check valve.
- C. Rotary Sprinklers: The sprinkler shall be capable of covering a 39-65 foot radius at 30 to 90 psi with a distribution rate of 2.9 to 21.7 GPM. The body of the sprinkler shall have a one (1) inch female inlet and a factory installed check valve.
- D. Full or Part Circle Pop-Up Spray Sprinkler: The sprinkler body. Stem, nozzle and screen shall be constructed of heavy-duty, ultra-violet resistant plastic. It shall have a heavy-duty stainless steel retract spring for positive pop-up and a ratcheting system for easy alignment of the patter.

The sprinkler shall have soft elastomer pressure activated co-molded wiper seal for cleaning debris from the pop-up stem as it retracts into the case.

Spray sprinklers using spray nozzles shall also include a check valve and an internal pressure-regulating device. These units shall be identifiable from the top with markings on the cap.

The check valve shall prevent low head drainage of up to ten (10) feet of head. The internal pressure-regulating device shall prevent high pressure fogging in the nozzle stream by regulating the nozzle pressure to 30 psi for inlet pressure from 35 to 70 psi. Below 35 psi the pressure loss shall not exceed 6 psi. These models shall utilize the bottom inlet only.

Sprinklers located above grade on risers will not require check valves due to potential freeze damage in areas of the country that may experience 32 and below degree temperatures while systems are still in operation.

- E. Small shrubbery sprinkler heads: The plastic shrub adaptor shall have a half (1/2) inch (FNPT) inlet and its fine-threaded outlet shall accept all plastic nozzles.

The plastic shrub adapter shall also include a built-in pressure regulator. The device shall regulate the nozzle pressure to 30 psi with inlet pressure from 35 to 70 psi, below 35 psi the pressure loss shall not exceed 6 psi.

A plastic shrub adaptor with pressure regulating device shall have a half (1/2) inch (FNPT) inlet and its fine-threaded outlet shall accept all brass and plastic nozzles.

Spray sprinkler nozzles will be fixed arc only. Adjustable arc spray nozzles are not acceptable unless authorized by the Landscape Architect or Irrigation Consultant under special circumstances where a fixed arc does not provide the coverage in a specific area. The exception is when MP rotator adjustable nozzles are being used.

- F. All types of sprinkler bodies (spray or rotors) are to be produced by the same manufacturer. A mix of product manufacturers is not acceptable.
- G. All turf sprinkler heads to be installed on four (4) elbow swing joints. All spray sprinklers that are irrigating plant material and are located in the mulched planting beds are to be mounted on a flex riser.

2.10 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 matching key(s).
- B. Quick coupling valves shall be used as a source to the pressurized main line so that a hose can be attached for manual hand watering. The quick coupling valve will be constructed of brass with a spring loaded seal that will keep the valve in a closed position until the key is inserted into the valve. The valve will also have a hinged locking purple rubber cover to prevent any debris getting into the internal mechanism of the valve. The cover shall be marked with “Do Not Drink” in English and Spanish. All quick coupling valves will be installed on a triple elbow swing joint. Provide size as indicated on drawings.
- C. Quick coupling keys shall be of the single lug variety. Attached to the key will be a hose swivel adapter sized to the commonly used hose on the project. The key and swivel will both be constructed of brass.

2.11 DRIP IRRIGATION SPECIALTIES

- A. Drip Irrigation Emitters: In-line self-cleaning, pressure compensating variety with individual check valves as indicated. In-line emitters will be spaced at twelve (12) inches on-center. Manual flush valves will be required at all locations necessary for maintenance flush and winterization blow down to assure water has been evacuated prior to freezing temperatures that would cause damage to the tubing and in-line emitters.
- B. Pressure Regulators: In-line pressure regulator sized as shown on Drawings. Maximum regulated pressure not to exceed 40 psi.
- C. Manual Flush Valves: All drip zones shall be installed with manual flushing valve(s), number of valves will be based on size of zones and location of “dead ends”.
- D. Application Pressure Regulators: Brass or plastic housing, NPS 3/4 (DN 20), with corrosion-resistant internal parts; capable of controlling outlet pressure to approximately 20 psig (138 kPa).
- E. Filter Units: Brass or plastic housing, with corrosion-resistant internal parts; of size and capacity required for devices downstream from unit.
- F. Air Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.
- G. Vacuum Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.

2.12 CONTROLLERS

- A. Description:
 - 1. Provide an electronic solid state hybrid controller system capable of fully automatic and manual operation of the system, made for control of irrigation system automatic control valves. Controller housing shall be wall or pedestal mounted, as indicated on the Drawings, in a weatherproof and lockable cabinet.
 - 2. Provide controller, which operates on a minimum of 110 volts AC power input and is capable of operating 24 volt AC electric remote control valves, with a reset circuit breaker to protect from overload. Contractor is responsible for connection to 120 VAC power to controller.
 - 3. Each state shall have a time setting which can be set for variable timing in increments from 0 to 60 minutes, or set to omit the station from the irrigation cycle.
 - 4. The controller shall have a calendar for setting the programmed start days, and a 24 hour clock for programming the irrigation cycle start time. A master “on-off” switch shall allow the valve power output to be interrupted without affecting the controller.
 - 5. The controller shall be constructed so that all internal parts are accessible through the controller door without disturbing the cabinet installation.
 - 6. Each controller location must be easily accessible for maintenance. Provide for the possibility of making minor timing adjustments to the controller in the field.
 - 7. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
 - 8. 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.
9. Concrete Base: Reinforced precast concrete not less than 36 by 24 by 4 inches (900 by 600 by 100 mm) thick, and 6 inches (150 mm) greater in each direction than overall dimensions of controller. Include opening for wiring.
- a. Concrete: Portland cement mix, 3000 psi.
 - 1) Cement: ASTM C 150, Type I.
 - 2) Fine Aggregate: ASTM C 33, sand.
 - 3) Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4) Water: Potable
 - b. Reinforcement: Steel conforming to the following:
 - 1) Reinforcement Bars: ASTM A 615, Grade 60, deformed.

2.13 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.
 - 1) Control Valves: 12 inches x 18 inches
 - 2) Backflow Preventer: 20 inches x 34 inches
 - 3) Isolation Valves, Wire Splices and Quick Coupling Valves: 10 inch diameter
 - b. Shape:
 - 1) Control Valves: Rectangular
 - 2) Backflow Preventer: Rectangular
 - 3) Isolation Valves, Wire Splices and Quick Coupling Valves: Round
 - c. Sidewall Material: PE.
 - d. Cover Material: PE.

- B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch (19 mm) minimum to 2 inches (30 mm) maximum.

2.14 IDENTIFICATION

- A. Section Cross Reference: Refer to Division 31, Earthmoving Section, for plastic underground warning tape requirements.

2.15 SLEEVES

- A. Class 200 PVC Pipe Type SDR 21:

2.16 SURGE PROTECTION EQUIPMENT

- A. Provide and install lightning arrestor for controllers not equipped with primary surge protection.

2.17 MISCELLANEOUS SYSTEM COMPONENTS

- A. Provide and install risers, reducers, couplings, adaptors, fittings as necessary to complete the irrigation system.
- B. Provide and install wireless rain sensor with adjustable shut-off point from one-eighth (1/8) inch to one (1) inch of accumulated rainfall. Provide and install freeze sensor that will cancel scheduled irrigation cycle if temperature is 37 degrees Fahrenheit or below. Switch will interrupt common wire. These units can be combined or separate. Unit shall be UL approved.

PART 3 - EXECUTION

3.1 GENERAL

- A. Observation of Work in Progress: During the installation, the Landscape Architect will make regular site visits and reject any work and materials which do not meet the requirements called for in the Contract Documents.
- B. Inspect project site prior to start of Work to determine that all site conditions are acceptable for Work to begin. Inform Landscape Architect of unsuitable conditions. Do not proceed with installation of irrigation system until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- C. Locate all existing underground utilities prior to trenching and/or boring operations and protect them against damage during the Work. Obtain utility locations from Owner and/or General Contractor and utilize utility locating services when necessary.

3.2 EXAMINATION

- A. Investigate and determine available water supply, water pressure and flow characteristics.

- B. When unanticipated utilities that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Owner for action.

3.3 EARTHWORK

- A. All excavation is unclassified and includes all materials encountered that are not classified as rock excavation.
- B. Report exceptions to Landscape Architect before excavation. An adjustment in price will be established which includes removal and disposal of the unsuitable material, and the acquiring of additional backfill material.
- C. Excavation of Newly Sodded Areas. Prior to excavation, remove sod, preserve and replace after backfilling is completed.
- D. Excavation in Established Grass or Newly Seeded Areas: After excavation and backfilling is completed, re-grade trenched are consistent with surrounding area and re-seed with 100 percent pure seed grass type existing. Mulch with straw and water.
- E. Excavation through existing asphalt, cutting, removal and replacement of asphalt, as noted on the Drawing, is the responsibility of the Irrigation Contractor.
- F. Backfill material shall be free from rocks, large stones, and other unsuitable substance which would damage the pipe or create unusual settling problems. Backfill in six (6) inch layers and tamp after each layer to prevent excessive settling.
- G. Backfill trenches containing plastic pipe when pipe is cool to avoid excessive contraction in cold water. Such backfilling can be done in early morning hours or the pipe may be water cooled prior to backfilling procedures.
- H. Install warning tape directly above pressure piping, 12 inches (300 mm) below finished grades, except 6 inches (150 mm) below subgrade under pavement and slabs.
- I. Provide minimum cover over top of underground piping according to the following:
 - 1. ½ inch – 1 inch pipe – minimum depth cover is 12 inches.
 - 2. 1 ¼ inch – 2 inch pipe – minimum depth cover is 18 inches.
 - 3. 2 ½ inch – 4 inch pipe – minimum depth cover is 36 inches.
 - 4. 6 inch – 8 inch pipe – minimum depth cover is 42 inches.
 - 5. 10 inch – 12 inch pipe – minimum depth cover is 54 inches.

3.4 FIELD QUALITY CONTROL

- A. Tests to be performed:
 - 1. Step Draw Down Test
 - 2. Constant Head Test
 - 3. Constant Rate Test

- B. Fabricators Representative: Pump station fabricator's representative shall be available for start-up and calibration of the pump station

3.5 SLEEVING

- A. Location of sleeving to be determined by the Contractor. Contractor to make adjustments necessary to accommodate existing vegetation, utilities and other existing conditions.
- B. Repair of damage to existing utilities, structures or other construction resulting from installation for sleeves is the responsibility of the Contractor.

3.6 PAVING WORK

- A. Section Cross Reference: Refer to Division 32 Asphalt Paving Section for cutting and patching of asphalt paving.
- B. Section Cross Reference: Refer to Division 32 Concrete Paving Section for cutting and patching of concrete paving.

3.7 PREPARATION

- A. Layout of Mains and Laterals: Layout sprinkler mainlines and perform line adjustments and site modifications to laterals prior to execution.
- B. Coordinate all installation with landscape planting work, especially fine grading, and soil preparation for planting areas.
- C. Coordinate and cooperate with all other contractors to enable the work to proceed as rapidly and efficiently as possible.
- D. Layout of Sprinkler Heads: Stake sprinkler head locations and check for uniformity of coverage and correctness of pattern.
- E. Valve Location: Locate valves to assure ease of access for maintenance and that no physical interference with other elements of the project exist. Valve boxes shall be placed a minimum of five (5) feet from walkways and roads. Valve boxes shall be located in planting beds and away from view of pedestrians.
- F. Furnish temporary support, adequate protection and maintenance of all underground and surface utilities, structures, drains, sewers and other obstructions encountered in the progress of the work.
- G. Contractor shall acquaint himself with all site conditions. Should utilities not shown on the plans be found during excavations, Contractor shall promptly notify the Owner for instructions as to further actions. Failure to do so will make Contractor liable for any and all damage thereto rising from his operations subsequent to discovery of such utilities not shown on the Drawing.

- H. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduit, ducts, pipe branch connections to sewer mains, main drains, water services, etc., the obstruction shall be permanently supported, relocated, removed, or reconstructed by the Contractor in cooperation with the Owner of such utility. No deviation from the required line or grade shall be made without the written direction of the Landscape Architect.

3.8 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 free of sags and bends.
- C. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- D. Install fittings for changes in direction and branch connections.
- E. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.
- F. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 (DN 65) or larger pipe connection.
- G. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.
- 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 (5 deg C). Allow joints to cure at least 24 hours at temperatures above 40 deg F (5 deg C) before testing.
- L. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- M. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- N. Install piping in sleeves under parking lots, roadways, and sidewalks.
- O. Install sleeves made of Schedule 80 PVC pipe and socket fittings, and solvent-cemented joints.
- P. Install transition fittings for plastic-to-metal pipe connections according to the following:
 - 1. Underground Piping:
 - a. NPS 1-1/2 (DN 40) and Smaller: Plastic-to-metal transition fittings.
 - b. NPS 2 (DN 50) and Larger: AWWA transition couplings.

2. Aboveground Piping:
 - a. NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings.
 - b. NPS 2 (DN 50) and Larger: Use dielectric flange kits with one plastic flange.
- Q. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, boring or jacking.
- R. Main Line: Install according to Manufacturer's Recommendations: Provide concrete thrust blocks at all directional changes in all pipe 3-inches and larger that is of the gasketed variety, as per Drawings.
- S. Lateral Lines and Risers:
 1. Install according to Manufacturer's Recommendations using standard techniques.
 2. Combine lateral lines and main supply lines in common trenches wherever possible.
 3. Install risers such that no excessive movement occurs while sprinkler head is in operation. Height of risers to be in accordance with planned and existing plant material. Height of risers to be in accordance with planned and existing plant material. Height of all risers is subject to approval of Owner.
 4. Plug lines immediately upon installation to minimize infiltration of foreign matter.
 5. Flush lateral lines and risers prior to installation of sprinkler heads.
 6. Above ground risers must be dark gray or black in color.

3.9 JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- B. 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.
- C. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- D. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
- E. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- F. 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.
- G. Dissimilar Materials Piping Joints: Construct joints using adapters that are compatible with both piping materials, outside diameters, and system working pressure.

3.10 VALVE INSTALLATION

- A. Valves: Install underground valves in valve boxes or pits.
1. Install according to manufacturer's recommendations, and as indicated on the Shop Drawings. Position boxes at a height that will not cause them to interfere with maintenance machinery (e.g. movers) and such that soil and mulch do not wash into the box. Locate valve box in mulched or natural areas one (1) foot inside the bed line. Where no mulched areas or natural areas exist within forty (40) feet of valve box locations install valve box in turf area. Install no more than two (2) valve boxes together when installed in turf areas.
- B. Control Valves: Install in control valve service box, arranged for easy adjustments and removal. Install union on downstream side.
- C. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size and capacity required. Include valves and test cock. Install according to plumbing code and health department authorities having jurisdiction.
- B. Install pressure-type vacuum breakers a minimum of twelve (12) inches above downstream piping system.
- C. Do not install bypass around backflow preventer.
- D. Do not install backflow preventers with drains or vents in pits or areas subject to flooding.
- E. Support backflow preventers, valves, and piping on 3000 psi minimum, portland-cement mix concrete piers.

3.12 PRESSURE REGULATOR INSTALLATION

- A. Install pressure regulators with shutoff valve and strainer on inlet and pressure gauge on outlet. Install shutoff valve on outlet and valved bypass where required.

3.13 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Low Pop-Up Sprinkler Heads: Install in such a manner that top is one (1) inch above finish grade. Where finish grade has not been established extend a riser a minimum of twelve (12) inches above existing grade to mark location of head. After finish grade is established, install heads as shown on Shop Drawings.
- D. High Pop-Up Shrub Heads: Install at heights required and/or as directed in the field by Landscape Architect.
- E. Backfill around sprinkler head assembly in such a manner as to stabilize the sprinkler head so that no lateral motion is exhibited during operation.
- F. Sprinkler Heads On Above-Grade Risers: Install as indicated on the Shop Drawings. High pop-up sprinkler heads shall be installed in landscape areas to retract out of sight when non-operational. Sprinklers installed on risers are not to be equipped with a check valve in the base. Water checked in the sprinkler could freeze causing damage to the sprinkler.

3.14 DRIP IRRIGATION SPECIALTY INSTALLATION

- A. Install drip tubes with direct-attached emitters on ground.
- B. Drip irrigation emitters are to be located in a manner that will provide optimum concentration of water to the plant material. Drip in-line emitter irrigation shall be installed in a grid pattern with manifolds to insure hydraulic balance. The grid pattern should allow for two parallel lines of drip tubing for every row of plant material, snaking is not acceptable. All drip zones shall be equipped with a pressure reducing valve not to exceed 40 psi and manual flush valves at the dead ends of the drip grids.

3.15 CONTROL WIRE INSTALLATION

- A. Install control wires in orderly fashion, locate in main line trench. Bundle wires together and tape at ten (10) foot intervals. Position wires to the right of the water supply line in the direction of the water flow.
- B. Provide looped slack at directional changes in supply line to allow for contraction of wires.
- C. Keep wire splices to a minimum and provide ten (10) inch round valve box at each splice location.
- D. Pass wires under existing or future paving, construction, etc., through PVC sleeves.
- E. For each open station on any given controller, there shall be spare wires to the furthest two (2) control valves located in diametrically opposed directions from the controller, plus one (1) additional spare wire.

3.16 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Install controllers according to manufacturer's written instructions and as required.
 - 1. Install surge protection equipment on primary (110 VAC) power lines. Connect each surge protection unit to at least one (1) five-eighths (5/8) inch diameter by nine (9) foot copper clad grounding electrode driven into the soil to its full depth. Place electrodes no closer than two (2) feet from controller cabinet or any control or power wire. Be consistent in locating ground rods throughout the installation with respect to controller positions.
 - 2. Ground wire between surge protection device and grounding electrode to be a single strand bare copper wire at least one size greater than the wire supplying power to the control unit. Route ground wire away from power and control wire where possible. When it is necessary to pass through the controller cabinet wall use two (2) #L-70 copper grounding lugs and a brass bolt. Use a #WE five-eighths (5/8) ground clamp rod and a ground wire. Bury ground wire passing between controller and ground rod a minimum of ten (10) inches. Cover the top of the rod and the clamp itself with a four (4) inch round cover with lid at grade level.

- B. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.
 - 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.
 - 3. Where dimensions are not indicated, furnish bases not less than thirty-six (36) inches by twenty-four (24) inches by four (4) inches thick, not less than six (6) inches greater in each direction than overall dimensions of controller.

3.17 CONNECTIONS

- A. Connect water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers.
- B. Connect piping to sprinklers, devices, valves, control valves, specialties and accessories.
- C. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- D. Connect wiring between controllers and automatic control valves.

3.18 IDENTIFICATION

- A. 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.

- B. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Division 31 Section "Earth Moving" for warning tapes.

3.19 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. 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.

3.20 ADJUSTING

- A. Balance and adjust the various components of the sprinkler system so that the overall operation of the system is most efficient. This includes synchronization of the controllers, adjustments to pressure regulators, part circle sprinkler heads, and individual station adjustments on the controllers.
- B. Adjust settings of controllers and automatic control valves.
- C. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- D. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than ¼ inch above, finish grade.
- E. Upon completion of the irrigation system, perform a coverage test with the Owner's representative to determine if the irrigation coverage is adequate. Correct any inadequacies.

3.21 CLEANING AND PROTECTION

- A. Flush dirt and debris from piping before installing sprinklers and other devices.
- B. Upon completion of Work, clear grounds of debris, superfluous materials and all equipment. Remove from site to the satisfaction of the Owner and/or landscape Architect.
- C. Protect the Work and materials from damage due to irrigation operations, operations by other contractor and trades and trespassers. Maintain protection until Date of Substantial Completion.

- D. Cover all openings into the system as it is being installed to prevent obstructions in the pipe and the breakage, misuse or disfigurement of the equipment.
- E. Theft: Irrigation Contractor is responsible for theft of equipment and material at the job site before, during and after installation, until Date of Substantial Completion of the Work in total.

3.22 DEMONSTRATION

- A. Upon completion of the Work and at a time and place acceptable to the Landscape Architect, and Owner, the Irrigation Contractor is responsible for the orientation of the Owner's maintenance personnel in the operation, maintenance, and repair of the system. Furnish copies of all available parts lists, troubleshooting lists and specification sheets, to the Landscape Architect.
 - 1. Operating and Maintenance Manuals shall constitute the basis of orientation.
- B. Set the initial watering schedules and programming of the automatic controllers at direction of Landscape Architect.

3.23 WINTERIZING THE SYSTEM

- A. The irrigation system shall be winterized the first winter season following Substantial Completion of the Project in total. The irrigation piping shall be winterized by first blowing the system clear of water using compressed air (80 psi maximum) admitted into the piping at a quick coupling valve or hose bib located at a higher elevation on the system piping. Activate individual zones, higher zones first, then proceed successively through the system towards lower elevations. Proceed through all zones twice. The air compressor used to winterize the system must have an engine separate from the compressor tanks to prevent high temperature air from being injected directly into the PVC piping.

3.24 OBSERVATION AND ACCEPTANCE

- A. Periodic site visits will be made by the Landscape Architect to review the quality and progress of the work. Work found to be unacceptable must be corrected within five (5) calendar days. Remove rejected materials promptly from the project.
- B. Upon completion of Work, the Contractor shall notify the Landscape Architect and Owner at least ten (10) days prior to requested date of the site visit for Substantial Completion of all portions of the Work. Landscape Architect will issue a punch list for work to be corrected. All work on the punch list must be completed within five (5) working days from the date of the site visit. Where Irrigation Work does not comply with requirements, replace rejected Work. If such replacements are not completed within the time specified, the Irrigation Contractor may be considered to be in default of the Contract, and the Owner may use the Contract Retainage to hire other Contractors to finish the Work.
- C. It will be the responsibility of the Irrigation Contractor to provide reliable communication system (i.e. two way radios or remote control activation system) for Substantial Completion and all periodic site visits.

- D. If a site visit to verify Substantial Completion has been scheduled and the Landscape Architect arrives at the site and determines that the irrigation system is not substantially complete (all system components in place, operational and checked) the Contractor shall be responsible for all costs incurred by the Landscape Architect to visit the site. Reimbursable expenses include but are not limited to the following: mileage, airfare, consultant's time, parking fees, meals, rental car, etc. All incurred expenses will be deducted from the final contract amount.
- E. Certificate of Substantial Completion will be issued for acceptable work and completion of "As-Built" Drawings, the Landscape Architect will verify the system for Substantial Completion. If punch list items are issued with the Certificate, they must be corrected within five (5) working days.

END OF SECTION 328410

SECTION 329000 - EXTERIOR LANDSCAPE

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. Extent of Landscape Work is indicated on Drawings and in schedules.
- B. Provide and furnish all labor, materials and equipment required or inferred from Drawings and Specifications to complete the Work of this Section.

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Division 00 Section "Proposal Form – Unit Price" or Division 01 Section "Unit Prices."
 - 1. Unit prices apply to authorized work covered by quantity allowances.
 - 2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.4 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 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. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.
- E. 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.
- F. Finish Grade: Elevation of finished surface of planting soil.

- G. **Manufactured Topsoil Backfill Media:** Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil for use in planting soil mix or topsoil planting backfill media.
- H. **Pesticide:** A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- I. **Pests:** Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- J. **Planting Area:** Areas to be planted.
- K. **Planting Soil Mix:** Standardized topsoil; existing, native surface topsoil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. **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.
- M. **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.
- N. **Stem Girdling Roots:** Roots that encircle the stems (trunks) of trees below the soil surface.
- O. **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.
- P. **Subsoil:** All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- Q. **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.

1.5 SUBMITTALS

- A. **Approval:** Obtain approval from Landscape Architect for all submittals prior to the beginning of Work, unless otherwise approved.
- B. **Section Cross Reference:** Refer to Division 01 Submittals Section for general requirements.
- C. **Topsoil Location and Sample:** Furnish Landscape Architect with written statement stating location of property from which topsoil is to be obtained, depth to be stripped, and crops grown during past two (2) years. Submit one (1) gallon Ziploc bag of topsoil proposed for use.

- D. Topsoil Test Report: Submit results of soil analysis by a qualified soil-testing laboratory, for information only, for standardized ASTM 5268 topsoil proposed for use in planting soil mixes. Report shall include percentages of deleterious materials; organic matter; gradation of sand, silt, and clay content, as determined by test methods included in Part 2 - Products; cation exchange capacity; pH level; mineral, major nutrient and micro nutrient content of top soil.
- E. Planting Soil Mix Sample: Submit one (1) gallon Ziploc bag of each proposed planting soil mix.
- F. Planting Soil Mix Test Report: Submit results of soil analysis by a qualified soil-testing laboratory, for information only, of each planting soil mix as specified. Report shall include percentages of organic matter; pH level; mineral content (percentage of sand, silt, and clay); major nutrient and micro nutrient content of each mix.
 - 1. State recommended quantities of nitrogen, phosphorus, potash and other nutrients and soil amendments to be added for suitable plant growth.
- G. Plant Material Photographs (if requested): Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Include a scale rod or other measuring device in each photograph. Image should represent the quality of all material delivered. Any plants not meeting all specified dimensions may be subject to rejection. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- H. On Site Soil Report: Submit results of soil analysis by a qualified soil-testing laboratory, for information only, of on site soil. Report shall include pH level, mineral; major nutrient and micro nutrient content of on site soil.
- I. Product Data: Submit, for information only, product data for proprietary materials and items, including soil amendments, soil conditioner, and other packaged and manufactured products.
- J. Soil Permeability Test Report: Submit laboratory test results of planting soil mix to be used in all structured planters. Planting soil mix shall be tested in accordance with ASTM D 2434.
- K. Tree Pit Drainage Certification: Submit written documentation certifying that results of drainage test on tree pits and planting beds comply with requirements contained here in.
- L. Fertilizer Analysis: Submit, for information only, label or technical data for fertilizer bearing the trade name, manufacturer's name, weight and analysis for fertilizers used in planting soil mixes and on sodded lawn areas.
- M. Planting Schedule: Submit planting schedule showing scheduled dates for each type of planting in each area of site. The Owner may require special schedule requirements for specific areas of the project, prior to beginning the Work.
- N. Certification: Prior to acceptance of plant material submit certificates of inspection as required by governmental authorities, and manufacturer's or vendors certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements. Submit seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species.

- O. Maintenance Instructions: Upon completion of the installation, submit typewritten recommendations for maintenance of any portion of the landscape which, in the opinion of the Contractor, requires special attention.
- P. Installer Certification: Submit written documentation certifying that Installer complies with requirements of "Installer Qualifications" below.
- Q. Filter Fabric: Submit, manufacturer's product data, for information only, including specifications, installation instructions and general recommendations.

1.6 QUALITY ASSURANCE

- A. Industry Reference Standards: Refer to Division 01 References Section.
National List of Scientific Plant Names, latest edition.
American National Standards Institute, Inc. (ANSI):
ANSI Z60.1 American Standard for Nursery stock by the American Association of Nurseryman.
- B. Qualifications:
 - 1. Installer Qualifications: Engage a firm specializing in landscape installation. Submit written documentation of successful completion of ten (10) projects of similar size, scope and complexity to work specified for this Project.
 - a. Firm Experience Period: Seven (7) years of experience.
 - b. Field Foreman Experience: Five (5) years of experience with installing firm.
- C. Soil-Testing Laboratory Qualifications: Engage a reputable independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct testing and analysis of existing surface soils representative of planting areas and lawn areas on site, new topsoil to be used in soil mixes and soil mixes with reference to specified plant materials. Soil report to include analysis of a minimum of three (3) soil samples from different locations for existing on site surface soils.
- D. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; [**sodium absorption ratio**]; deleterious material; pH; and mineral and plant-nutrient content of the soil.
 - 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
 - 2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be take per instructions from Landscape Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
 - 3. Report suitability of tested soil for plant growth.
 - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd. (0.76 cu. m.) for nitrogen, phosphorus, and potash

nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

- b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- E. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
1. Selection of plants purchased under allowances will be made by Landscape Architect, who will tag plants at their place of growth before they are prepared for transplanting.
- 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. Certain tree species, particularly conifers, may have extended leaders which protrude well beyond the body of the crown. In such cases, only the first foot of growth of the leader beyond the closest side branch will count towards its overall height measurement. 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. Each plant procured for the project must, at the minimum, meet all of the specified size parameters listed, i.e. caliper, height, spread, container size, comment. The Landscape Architect has the right to reject any material that falls short of the specified sizes.
 3. All container sizes listed are full sizes (e.g. one gallon must fit the dimensions of a full one gallon pot). No trade gallons will be acceptable unless prior approval is granted by the Landscape Architect.
 4. Other Plants: Measure with stems, petioles, and foliage in their normal position.

1.7 MATERIAL QUANTITIES:

- A. It is the Contractor's responsibility to total and confirm all material quantities. Items quantified by an area (i.e., square feet - sf., square yard - sq. yd.) or volume (cubic feet - cu. ft., cubic yard - cu. yd.) shall be calculated and confirmed by the Contractor. The quantities listed on the plant list are estimated. In the event of a discrepancy between the totals listed on the plant list and the numerical callouts on the Drawings, the Drawings shall govern. The actual total quantities shall be determined by the Contractor.
1. The plants listed on the unit price proposal form in the project manual is provided for convenience. In the event of a discrepancy between the unit price proposal form and plant quantities indicated on the Drawings, the Drawings shall govern.

1.8 MATERIAL SIZES:

- A. It is the Contractor's responsibility to confirm that the sizes indicated on the Drawing callouts match the sizes on the Drawing plant list. The plants list on the Drawings is provided for

convenience and is only a summary. In the event of a discrepancy between the sizes on callouts and the plant sizes indicated on the Drawing plant list, the larger of the two sizes shall govern. The Contractor shall bring any discrepancy to the Landscape Architect's and Owner's attention.

1. The plants listed on the unit price proposal form in the project manual is provided for convenience. In the event of a discrepancy between the unit price proposal form and the plant sizes indicated on the Drawing callouts, the Drawings shall govern.

1.9 DELIVERY, STORAGE AND HANDLING:

- A. Packaged Materials: Deliver packaged materials in original and unopened containers showing weight, certified analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored on site.
- 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 fertilizers[, lime,] and soil amendments with appropriate certificates.
- C. Sod: Time delivery so that sod will be placed within twenty-four (24) hours after stripping. Protect sod against drying and breaking of rolled strips.
- D. Trees, Shrubs and Ground Cover: Provide freshly dug trees and shrubs. Do not prune prior to delivery. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches or destroy natural shape. Provide protective covering during shipment.
 1. 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.
- E. Deliver trees, shrubs and ground cover after preparations for planting have been completed and plant immediately. If planting is delayed more than six (6) hours after delivery, set trees, shrubs and ground cover in shade, protect from current and forecasted weather and mechanical damage, and keep roots moist.
 1. Set balled stock on ground or in partially excavated hole and cover rootball with soil, peat moss, sawdust or other acceptable material.
 2. Do not remove container-grown stock from containers until planting time.
 3. Heal-in bare-root stock. Soak roots in water. Do not let roots dry out.
 4. Water root systems of plant material stored on-site. Water as often as necessary to maintain root systems in a moist condition.
- F. Label at least one (1) tree of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name. All shrubs and groundcovers should bear professional pre-printed tags. Any shrubs or groundcovers not supplied with tags may be rejected by the landscape architect if deemed to be the incorrect species or cultivar.

- G. Do not remove labels attached to plant material by the Landscape Architect until directed to do so.

1.10 PROJECT CONDITIONS:

- A. Insurance on plant material and other materials stored or installed is the responsibility of the Contractor. Such insurance shall cover fire, theft, vandalism and other unusual phenomenon. Should the Contractor elect not to provide such insurance, he will in no way hold the Owner responsible for any losses incurred by the aforementioned acts. The Contractor is responsible for all costs incurred in replacing damaged or stolen materials prior to Date of Substantial Completion of the Work.
- B. Proceed with and complete landscape work as rapidly as portions of Site become available, working within seasonal limitations for each kind of landscape work required.
- C. Existing Grades: Existing grades will be within 0.2 feet of grades shown on the Civil Engineering Drawings when landscape work is to begin. Determine condition of existing grades prior to beginning the Work. When irregular or incomplete grading conditions are encountered, notify the Owner in writing before beginning the Work. Determine location of existing drainage patterns and maintain patterns in completed Work. Perform Work in a manner which will avoid damage to finished grading and drainage patterns. All damage to finished grading and drainage resulting from Work covered in these Contract Documents shall be repaired at the Contractor's expense.
- D. Existing Utilities: Determine location of underground utilities. Perform Work in a manner which will avoid possible damage. Excavate as required. Maintain grade stakes set by others unless removal is mutually agreed upon by parties concerned. All damage to utilities resulting from Work covered in these Contract Documents shall be repaired at the Contractor's expense.
- E. Existing Conditions: Perform landscape Work in the Tree Protection Zones and in existing or previously completed landscape areas to avoid damage and disturbance to these areas. Limit work in these areas to only that necessary to perform work specified herein and shown on the Drawings. Return and repair any areas damaged or disturbed while performing the Work to the existing conditions encountered prior to the Work.
- F. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect in writing before planting.
- G. Weather Limitations: Proceed with planting when existing and forecasted weather conditions are suitable.
- H. Planting Schedule: Prepare a proposed planting schedule. Schedule dates for each type of landscape work during contract period. Coordinate schedule with General Contractor and Irrigation Contractor.
- I. Coordination With Turf Areas (Lawns): Plant trees and shrubs after final grades are established and prior to planting of turf, unless otherwise acceptable to Landscape Architect. If planting of trees and shrubs occurs after turf Work, protect turf areas and promptly repair damage to turf areas resulting from plant operations.

1.11 WARRANTY:

- A. Warranty for a period of one (1) year, following the Date of Substantial Completion, all trees, shrubs, groundcovers, plants and grass against any defects including death and unsatisfactory growth, as determined by the Landscape Architect. Warranty shall include the complete cost to supply and install all replacement plant materials according to the requirements herein. Defects resulting from lack of adequate maintenance, neglect or abuse by the Owner, abuse or damage by others, or unusual phenomenon or incidents beyond the Contractor's control are excepted. Should questions arise concerning the responsibility of replacement, the Landscape Architect will be available for arbitration provided the Owner and Contractor mutually desire.
- B. Remove and replace all trees, shrubs, groundcovers and lawn, or other plants found to be more than 25 percent dead or in unhealthy condition during warranty period as determined by Landscape Architect or Owner. Make replacements immediately unless required to plant in the succeeding planting season.
- C. Replacements: Match adjacent specimens of same species. Replacements are subject to all requirements stated in the Contract Documents and are subject to observation by the Landscape Architect prior to digging.
- D. Repair grades, lawn areas, paving and any other damage resulting from replacement planting operations, at no additional cost to the Owner.
- E. Inspect Project site monthly during warranty period to determine what changes, if any, should be made in the maintenance program. Submit all recommended changes in writing to the Landscape Architect and the Owner.
- F. Replacements made during the Warranty Period or following the site visit for Final Acceptance will carry an additional one (1) year warranty beginning at the time of replacement.

PART 2 - PRODUCTS

2.1 SOURCE QUALITY CONTROL:

- A. General: Only plant material grown in a recognized nursery in accordance with good horticultural practice will be accepted. Provide healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun-scald, injuries, abrasions or disfigurement.
- B. Observation of Plant Material Prior to Digging:
 - 1. Contractor must locate all plant material to be supplied for the Project and inform the Landscape Architect in writing of location within thirty (30) days of the date of the Contract or notice to proceed, which ever is first.
 - 2. The Landscape Architect may select and tag the trees required for the Project, at the Contractor's sources. In any event the Landscape Architect shall approve 100 percent of the trees required for the Project.
 - 3. In the event plant material is found to be unacceptable, the Contractor will pursue other sources until acceptable plant material is found, at no additional cost to the Owner. If, due to unacceptable plant material at the Contractor's source, additional tagging trips are

required by the Landscape Architect, the Contractor will reimburse the Landscape Architect for his time and travel expenses.

4. Approval at the plant source does not impair the right of the Landscape Architect to observe and reject material at the time of shipping or during progress of the Work.

C. Shipping:

1. Ship landscape materials with certificates of inspection required by governing authorities. Inspection by Federal and/or State Governments at Grower does not preclude rejection of plants at the site by the Landscape Architects. Comply with regulations applicable to landscape materials. Prepare plants for shipment to prevent damage to the plants.
2. From March 15th to September 15th, ship plant material to be transported over one hundred (100) miles at night only. Make arrangements to have plant material watered during shipment as necessary to avoid excessive stress. Plant material may be rejected if not properly shipped.
3. Do not ship plant material in temperatures below 20 degrees Fahrenheit.

- D. Do Not Make Substitutions: If specified landscape material is not obtainable, submit to Landscape Architect proof of non-availability and for use of equivalent material. For proof of non-availability submit a written statement from a minimum of six (6) reliable nursery sources (American Nurserymen's Association Members) that the plant in question is not obtainable in the Eastern United States.

- E. Analysis and Standards: Package standard products with manufacturer's certified analysis. Including but not limited to:

1. Soil Amendments
2. Grass Materials
3. Mulch

- F. Approval and Selection of Materials and Work: The selection of all materials and the execution of all operations required under the Drawings and Specifications is subject to the approval of the Landscape Architect. The Landscape Architect has the right to reject any and all materials and any and all Work which, in his opinion, does not meet the requirements of the Contract Documents at any stage of the operations. The Contractor shall remove rejected work and/or materials from Project site and replace promptly.

2.2 TOPSOIL:

- A. Topsoil has not been stockpiled for re-use in planting soil and other Landscape Work.
- B. Provide new topsoil which is fertile, friable, pervious, sandy loam, surface soil; free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than one and one-half (1½) inches in any dimension, and other extraneous or toxic matter harmful to plant growth.
- C. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at Project Site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than four (4) inches; do not obtain from bogs or marshes, unless specified.

- D. Topsoil: ASTM D 5268 complying with the following composition as determined by the indicated test methods:
1. Deleterious Materials: 2 percent max. by mass; ASTM D 2487. (Rock, gravel, slag, cinder, stone).
 2. Organic Material: 5-10 percent min. by mass; ASTM D 2974.
 3. Sand Content: 20 - 60 percent by mass.
 4. Silt Content: 20 - 60 percent by mass.
 5. Clay Content: 20 - 40 percent by mass.
 6. pH Range: 5 to 6.5; ASTM D 4972.

Topsoil should fall into the range clay loam, loam or silt loam on the USDA Soil Texture Triangle.

2.3 INORGANIC SOIL AMENDMENTS:

- A. Lime: ASTM C 602, Class T, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 sieve and a minimum 75 percent passing a No. 60 sieve.
- B. Aggregate Soil Conditioner: Rotary kiln expanded slate specially graded for use as a horticultural soil conditioner with the following composition as determined by the indicated test methods:
1. Dry Loose Unit Weight: 48-55 lbs/cu.ft.; ASTM C 29.
 2. Specific Gravity: To meet 1.45 to 1.60 dry bulk; ASTM C 127.
 3. Gradation: 3/8-inch to No. 8; ASTM C 330 with 100 percent passing the 3/4-inch sieve.
 4. Absorption: Five percent or more; ASTM C 127.
 5. LA Abrasion: Weight loss between 20 percent and 30 percent; AASHTO T 96.
 6. Chemical Characteristic:
 - a. pH: 6.5 to 10 range.
 - b. Soluble salts: To meet horticultural rural range of 0.75 to 3.5 mmhos/cm.
 7. Process the slate using only non-hazardous fuels such as coal or natural gas.
 8. The expanded slate shall be free of clay lumps and organic impurities.
 9. Obtain aggregate soil conditioner from a single supplier.
 10. Available Products: Subject to compliance with the requirements, aggregate soil conditioners that may be incorporated in the Work includes, but is not limited to the following:
 - a. Acceptable Supplier and Products:
 - 1) Supplier: Caroline Stalite Company
 - a) Product: 5/16-inch Perma Till

- C. Coarse Sand: Clean, washed, natural or manufactured sand, free of extraneous or toxic matter with the following grain size distribution or coarser; ASTM C136.

Sieve Size	% Passing
.5 in.	100.0

.375 in.	98.0
#4	98.0
#10	93.0
#20	21.0
#60	1.0
#140	0.5
#200	0.5

2.4 ORGANIC SOIL AMENDMENTS:

- A. Compost: 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 4 to 6 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: 50 percent minimum of dry weight.
 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste that meet all State Environmental Protection Agency requirements.
 3. Available Products: Subject to compliance with the requirements, compost products that may be incorporated in the Work includes, but is not limited to the following:
 - a. Acceptable Supplier and Products:
 - 1) Supplier: EARTH Products, LLC
 - a) Product: EARTH Food
 - 2) Supplier: It Saul Natural, LLC
 - a) Product: Hen Manure Compost
- B. Humus: Air dried, finely shredded, and pH range suitable for intended horticultural use. Humus shall be completely decomposed forest type including composted leaves, bark and organic wastes.
- C. Peat: Air dried, finely shredded or granular texture, completely decomposed and free of fibers with pH range suitable for intended horticultural use. Peat shall be a naturally occurring, highly organic and derived primarily from plant materials.
- D. Manufactured Organic Soil Amendment: Composted and screened 100 percent organic manufactured soil amendment.
1. Acceptable Supplier and Products:
 - a. Supplier: It Saul Natural, Inc.
 - 1) Product: Mr. Natural CLM.
 - 2) Product: Mr. Natural WSM.
 - b. Supplier: EARTH Products, LLC

1) Product: Total Landscape Planting Mix.

- E. Shredded Pine Bark: Shredded bark pieces between one-quarter (1/4) inch and one (1) inch in length with partially decomposed bark matter.

2.5 FERTILIZER:

- A. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial phosphate mixture, soluble, minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-released nitrogen, 50 percent derived from natural organic sources, phosphorous, and potassium in the following composition:
1. General: For trees, shrubs and ground cover, provide a homogeneous fertilizer complete with micro nutrients having an analysis of 12-4-8 (12 pounds of nitrogen, 4 pounds of available phosphoric acid, and 8 pounds of water soluble potash respectively for each 100 pounds of mixture).
 2. For trees, shrubs, and ground cover provide fertilizer with adjusted analysis in accordance with results and recommendations of planting soil mix test reports.
 3. For lawns, provide fertilizer in accordance with results and recommendations of existing on site surface soil report relative to lawn installation. Provide nitrogen in a form that will be available to lawn during initial period of growth.
- D. Slow-Release Fertilizer: Granular or pelleted 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 existing on site surface soil reports from a qualified soil-testing laboratory.
- E. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.6 PLANTING SOIL:

- A. Planting Soil Mix For On-Grade Plantings: Provide soil mix amended as per laboratory recommendations. Basic planting soil mix consists of:
1. Topsoil (as specified): 70 percent
 2. Organic soil amendments (by volume as follows): 30 percent
 - a. 2 parts humus, peat, and/or nutrient grade compost
 - 1) Compost shall be manufacturer by a composter enrolled in the United States Compost Council (USCC) Seal of Testing Assurance (STA) Program.

- b. 1 part shredded and partially composted pine bark (bark pieces 1/2 inch maximum length)
 - c. 1 part sterilized composted cow manure
 3. Commercial fertilizer as recommended in soil report
 4. Lime as recommended in soil report
 - B. Planting Soil Mix for Rhododendron/Azalea Plantings: Provide manufacturer's pre-mixed soil mix.
 1. Acceptable Manufacturer and Product:
 - a. Manufacturer: It Saul Natural, LLC.
 - 1) Product: Mr. Natural Woodland Soil Mix.
 - C. Planting Soil Mix for Annual Color and Perennial Plantings: Provide manufacturer's pre-mixed soil mix.
 1. Acceptable Manufacturer and Product:
 - a. Manufacturer: It Saul Natural, LLC.
 - 1) Product: Mr. Natural CLM
 - D. Planting Soil Mix for Sod/Turf Plantings: Provide soil mix amended as follows by volume:
 1. 40 percent topsoil
 2. 20 percent compost
 3. 30 percent sand (coarse river sand)
 4. 10 percent Hydrocks Expanded lightweight aggregate
 - E. Humus shall be omitted from planting soil mixes if topsoil used has an organic content of 40 percent or greater as determined by the topsoil test report.
 - F. Planting Soil Mix For Planters: Provide type of soil mix as indicated above for specific type of planting/plant materials to fill the top ten (10) inches of all above grade planters. Remaining depth of planter to be filled with specified topsoil. Contractor to have planting soil mix tested by an independent laboratory for compatibility with soil separator and drainage medium.

2.7 PLANT MATERIALS:

- A. General:
 1. Provide plants true to species and variety, complying with recommendations of ANSI Z60.1 "American Standard for Nursery Stock". Nomenclature to comply with "National List of Scientific Plant Names."
 2. Specific requirements concerning plant material and the manner in which it is to be supplied are shown on the Drawings and plant list.
 3. Plant material indicated as pre-tagged and pre-purchased on the Drawings has been selected and purchased for the Project by the Owner at the nursery indicated. Contractor

shall be responsible for the total installation of the material including freight, labor, profit, complete warranty and replacement, and all items specified herein and as indicated on the Drawings.

4. Acclimatization: Plants must have grown under climatic conditions similar to those of the locality of the project site for a minimum of two (2) years immediately prior to being planted on the Project.

B. Quality and Size:

1. Furnish nursery grown plants, freshly dug, normally shaped and well branched, fully foliated when in leaf and with healthy well developed root systems. Plants to be free of disease, insect infestations or their eggs and larvae, and defects such as knots, sun scald, injuries, abrasions and disfigurement.
2. Furnish plants to match as closely as possible whenever symmetry is called for.
3. Provide trees and shrubs of sizes shown or specified. Trees and shrubs of larger size may be used if acceptable to the Landscape Architect, and if sizes of roots or rootballs are increased proportionately. The increased size will not result in additional cost to the Owner.
4. Stock Specified in a Size Range: Within each size range not less than 50 percent the plants must be of the maximum size specified.
5. Balled and Burlapped Plants: Plants designated "B&B" are to have firm, natural balls of soil corresponding to sizes specified in ANSI Z60.1 "American Standard for Nursery Stock". Balls to be firmly wrapped in biodegradable burlap and securely tied with biodegradable heavy twine, rope and/or wire baskets. Plants with loose, broken or manufactured rootballs will be rejected. Rootballs shall be lifted from the bottom only, not by stems or trunks.
6. Container grown plants in cans, plastic containers or timber boxes will be acceptable in lieu of balled and burlapped plants provided that they are of specified quality. The container must be removed prior to planting, with care being exercised as to not injure the plant.

C. Trees:

1. Provide trees of height and caliper listed or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are specified in the Contract Documents.
2. Provide self supporting trees with straight trunks and leaders intact. Where required in the Contract Documents, provide trees with character as described.
3. Determining dimensions for trees are caliper, height and spread. Caliper shall be measured six (6) inches above ground for trees up to and including four (4) inch caliper. Trees over four (4) inch caliper shall be measured twelve (12) inches above ground. Specified height and spread dimensions refer to the main body of the plant and not branch tip to tip. Take measurements with branches in natural position.

- D. Tree Forms: Do not limb up tree forms more than two (2) feet before planting. Prune to desired shape as directed by Landscape Architect.

- E. Shrubs: Provide established and well-rooted plants, in removable containers, with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

- F. Ground Cover: Provide established and well-rooted plants, in removable containers or integral peat pots, having not less than minimum number and length of runners by ANSI Z60.1 for the pot size specified.
- G. Grass Materials:
 - 1. Grass Seed: Provide fresh, clean, new crop-seed complying with tolerance for purity and germination established by Association of Official Seed Analysts. Provide seed of grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified on Drawings.
 - 2. Sod: Provide viable sod of uniform density, color, and texture, strongly rooted, not less than two (2) years old and free of weeds and undesirable native grasses. Only provide sod capable of growth and development when planted (viable, not dormant). Provide machine cut sod of a uniform minimum soil thickness of five-eighths (5/8) inch, plus thickness of top growth and thatch. Sod pieces to be consistent in size and shape. All sod must be a true certified turfgrass.

2.8 MISCELLANEOUS LANDSCAPE MATERIALS:

- A. Burlap for wrapping earthball shall be biodegradable jute mesh not less than 7.2 oz. per square yard. Wrapping materials made from man made fibers are unacceptable.
- B. Guy Stakes, Upright Stakes, and Deadmen: Grade No. 2 or better, uniform grade pressure preservative treated pine AWWPA C-2, or sound new hardwood or redwood free of knots, holes and other defects, two (2) by two (2) inches by thirty (30) inches long, pointed at one end.
- C. Guy Anchors: No. 4 rebars or comparable size steel stakes, three (3) feet in length.
- D. Guys and Wire Ties: 2-strand, twisted, pliable galvanized steel wire not lighter than No.12 gauge.

****OR****

- D. Arbortape: generic name; rot resistant, flat woven polypropylene or similar material, 3/4 inch wide min., 900 lb break strength min., resistant to degradation by the sun, cold weather, chemicals and contact with soil.
 - 1. Color: Green/Olive
- E. Hose: One half (1/2) inch diameter black reinforced rubber or plastic garden hose. Cut to required lengths to protect tree trunks from damage by wires. Used hose is acceptable.
- F. Palm Bracing: Battens or blocks, struts, straps, and protective padding as indicated.
 - 1. Battens or Blocks and Struts: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-4-inch nominal (38-by-89-mm actual) by lengths indicated.
 - 2. Straps: Adjustable steel or plastic package banding straps.
 - 3. Padding: Burlap.

- G. Drainage/Separation Fabric: Manufacturer's standard nonwoven pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination.
 - 1. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test method:
 - a. Grab Tensile Strength (ASTM D 4632): 100 lb.
 - b. Apparent Opening Size (ASTM D 4751): #100 U.S. Standard Sieve.
 - c. Permeability (ASTM D 4491): 150 gallons per minute per sq. ft.
- H. Drainage Gravel: Washed crushed stone.
- I. Water and water transportation is the sole responsibility of the Contractor.
- J. Mulch:
 - 1. Cypress Bark Mulch: Premium grade shredded and ground, one (1) inch maximum particle size in any dimension.
- K. Lawn Anti-Erosion Mulch: Clean, threshed straw of wheat, rye, oats or barley.
- L. Anti-Desiccant: Water-insoluble emulsion type, film-forming agent designed to permit transpiration but retard excessive loss of moisture from plants. Deliver in manufacturer's fully labeled containers and mix in accordance with manufacturer's instructions.
- M. Drainage Matt: Provide prefabricated drainage matt with integral non-woven filter fabric. Weight of filter fabric to be determined from results of permeability test in accordance with ASTM D 2434.
 - 1. Acceptable Manufacturer's and Products:
 - a. Manufacturer: Mirifi Inc.
 - 1) Product: Mira Drain 6000
 - b. Manufacturer: ECM, Inc.
 - 1) Product: Ultra Drain I
 - c. Manufacturer: Grace Construction Products
 - 1) Product: Hydroduct Drainage Composite
- N. Drain Pipe and Fittings: Corrugated perforated polyethylene drain tubing, black, meeting ASTM F 405.
- O. Drain Basins and Grates: Black meeting in ASTM D 1892 and ASTM D 4549. As shown on the Drawings.

PART 3 - EXECUTION

3.1 PREPARATION:

A. General:

1. Contractor shall examine conditions under which planting is to be installed, review applicable architectural and engineering Drawings, and be familiar with alignment of underground utilities before digging.
2. Planting Time: Planting operations are to be performed at such times of the year as the job may require, with the stipulation that the Contractor guarantees the plant material as specified. Plant only during periods when weather conditions are suitable.
3. Verify layout information shown on the Drawings, in relation to property survey and existing bench marks before proceeding to layout the work. Locate and protect existing benchmarks and control points. Preserve reference points (coordinates) shown on the Drawings during construction.
4. Work from lines established by the property survey, established bench marks and markers to set coordinate points for the tree locations on the Project. Calculate and measure required dimensions. Do not scale Drawings to determine dimensions.
5. Tree Locations: Locate and layout tree (coordinate) locations by instrumentation and similar appropriate means.
6. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Landscape Architect's acceptance before start of excavation for planting work. Make adjustments as requested.
7. Notify Landscape Architect of adverse sub-surface drainage or soil conditions. State conditions and submit a recommendation for correction including costs. Obtain approval for method of correction prior to continuing Work in the affected area. In the event that alternate locations are selected, the Contractor shall prepare such areas at no additional expense to the Owner.

B. Excavation for Trees and Specimen Shrubs:

1. Excavate pits, beds and trenches with vertical sides, as specified and as shown on the Drawings.
2. Loosen hardpan and moisture barrier until hardpan has been broken and moisture is allowed to drain freely.
3. For balled and burlapped (B&B trees and shrubs), make excavations at least four (4) feet wider than the ball diameter for the top twelve (12) inches of the pit. For the remaining depth of the pit, excavate at least two (2) feet wider than the full diameter and equal to the ball depth, plus an allowance for setting of ball on a layer of compacted backfill. Allow for six (6) inch minimum setting layer of excavated soil.
4. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.

C. Test Drainage:

1. Tree and Specimen Shrub Pits: Fill each pit with water. If percolation is less than 100 percent within a period of twelve (12) hours, drill a ten (10) inch diameter auger hole to a depth up to five (5) feet below the bottom of the pit. Fill auger hole with drainage gravel and cover with filter fabric. Retest pit. In case drainage is still unsatisfactory, notify Landscape Architect, in writing, of the condition before planting trees in the questionable areas. Contractor is fully responsible for warranty of the plant material.

D. Subsoil Removal:

1. Dispose of subsoil removed from landscape excavations at an off-site location. Do not mix with planting soil. Do not use as backfill.

3.2 FIELD QUALITY CONTROL:

- A. Testing: Contractor shall employ testing agency to perform soil permeability test in accordance with ASTM 2434 on planting soil mix to be used in structured planters prior to procuring and installing drainage matting. Test results shall be used to determine weight of integral non-woven filter fabric.

3.3 PREPARATION OF PLANTING SOIL:

- A. Before mixing, clean topsoil, or existing surface soil if using a soil conditioner, of roots, plants, clods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
- B. Mix specified soil amendments and fertilizers with topsoil, or soil conditioner with existing surface soil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
- C. For pit and trench type backfill, mix planting soil prior to backfilling and keep covered until used.
- D. For planting soil prepared with a manufactured soil conditioner, mix planting soil in large batches before backfilling, stock pile for use at site and keep covered until used. Do not mix soil conditioner at individual planting sites.
- E. For groundcover and shrub beds, mix planting soil either prior to planting or apply on a surface layer over prepared bed area and mix both thoroughly in the bed before planting.
 1. Mix lime, if required, with dry soil prior to mixing of fertilizer.
 2. Prevent lime from contacting roots of acid-loving plants.
 3. Apply phosphoric acid fertilizer (in addition to that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.

3.4 PREPARATION OF SHRUB AND GROUNDCOVER PLANTING BEDS:

- A. Layout planting beds on the ground to the lines shown on the Drawings. Have layout approved by Landscape Architect prior to constructing the bed.
- B. Outline bed with a trench edge as shown on the Drawings. Place soil for trench edge within bed area.
- C. Loosen existing soil to a minimum depth of twelve (12) inches using a roto tiller or similar equipment. Remove all sticks, stones, rubbish and other material detrimental to plant growth.
- D. Spread four (4) inch minimum layer of planting soil mix over entire bed area. (Additional soil mix may be necessary to build up shrub beds to grade as shown on the Drawings.) Work planting soil mix into top of loosened soil with roto tiller.

- E. Smooth planting areas to conform to specified grades after settlement has occurred. Slope surface of shrub beds to drain toward the trench edge.
- F. Mass preparation of beds is not applicable for areas exceeding 4:1 slope.

3.5 PREPARATION OF PLANTERS:

- A. Planters: Place drainage and filter materials in bottom of planters according to the Drawings and fill with planting soil mix. Place soil in lightly compacted layers to an elevation one and one-half (1-1/2) inches below top of planter. Crown soil according to the Drawings.
- B. Take precautions to maintain integrity of waterproofing.
- C. Notify Landscape Architect of any damage or defects in planter waterproofing prior to planting.

3.6 PREPARATION OF ANNUAL COLOR AND PERENNIAL BEDS:

- A. Excavate bed to a depth of four (4) inches, break through 'hard pan' and remove all stone, roots, debris, etc. Remove excavated soil.
- B. Roto till excavated bed to a depth of six to eight (6-8) inches.
- C. Slope the base of the bed to the trench edge.
- D. Spread six (6) inch minimum layer of planting soil mix over entire bed. Work planting soil mix into top of loosened soil with roto tiller.
- E. Place additional planting soil mix to build up bed a minimum of six (6) inches above existing grade for annual color beds and four (4) inches above existing grade for perennial beds. Roto till entire bed to a depth of twelve (12) inches.

3.7 PREPARATION FOR PLANTING LAWNS:

- A. Loosen the grade of lawn areas to a minimum depth of twelve (12) inches. Remove stones over one and one-half (1½) inches in any dimension and sticks, roots, rubbish and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.
- B. Place approximately one-third (1/3) of total amount of sod planting soil. Work into top of loosened subgrade to create in two (2) layers a transition layer and then place remainder of topsoil mixture to minimum depth required to meet lines, grades and elevations shown, after light rolling and natural settlement.
- C. Allow for sod thickness in areas to be sodded.
- D. Grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.

- E. Fertilize and lime prior to start of grassing operation. Apply ground limestone at the rate recommended by soil test analysis and work into top twelve (12) inches of soil. Apply fertilizer at the recommended rate; work into top two (2) inches of soil. The fertilizer application shall not precede the placement of sod by more than three (3) days.
- F. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
- G. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
- H. Preparation of Unchanged Grades: Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows: Till to a depth of not less than six (6) inches; apply soil amendments and initial fertilizers as specified; remove high areas and fill in depressions; till soil to a homogenous mixture of fine texture, free of lumps, clots, stones, roots and other extraneous matter. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such material outside of Owner's property; do not turn over into soil being prepared for lawns.

3.8 PLANTING TREES AND SPECIMEN SHRUBS:

- A. Set balled and burlapped (B&B) stock on layer of compacted excavated existing soil, plumb and in center of pit or trench with top of ball two to three (2-3) inches above the finish grade and also two to three (2-3) inches above the grade they bore to natural grade before transplanting. Remove all straps and ropes made of man-made fibers completely from rootball. Loosen and remove burlap and biodegradable ropes from top half of rootball. Cut and remove the top half of all wire baskets before backfilling. Use planting soil mixture to backfill plant pits. When plants are set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately two thirds (2/3) full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
- B. Remove all man made or impervious materials from the rootball and trunk before final installation of trees and specimen shrubs.
- C. Set container grown stock as specified for balled and burlapped stock, except remove containers, without damaging rootballs, prior to backfilling.
- D. Apply anti-desiccant using power spray to provide an adequate film over trunks, branches, stems, twigs and foliage. If deciduous trees or shrubs are moved in full leaf, spray with anti-desiccant at nursery before moving and again after planting as per manufacturer's recommendations.
- E. Mulching: Immediately after planting work has been completed, mulch pits, trenches and planting beds. Provide a minimum depth of two (2) inches of bark or three (3) inches of pinestraw. Finish edges according to the Drawings.
- F. Water: Soak all plants immediately after planting, continue watering thereafter as necessary until Date of Substantial Completion.

- G. Smooth planting areas to conform to specified grades after full settlement has occurred and mulch has been applied.

3.9 STAKING, GUYING AND PRUNING:

- A. Stake and guy trees immediately after planting. Plants shall be plumb after staking or guying. Maintain stakes, wires and guys until Final Acceptance of the Work.
- B. Staking trees of one (1) inch caliper and under or four (4) feet height: Use single stake with rubber hose and wire loop around trunk. Use only wooden stakes as specified.
- C. Staking trees of one (1) inch caliper and up to two and three quarters (2-3/4) inch caliper: Drive two stakes, 180 degrees to each other, securely into ground and fasten to tree with wire and tie. Use hose around wire so wire is not in contact with plant, or use Cinch-tie of appropriate size. Adhere to staking details unless alternate detail has been approved by Landscape Architect prior to beginning of planting operation.
- D. Guying trees of three (3) inch caliper and larger: Guy trees according to detail. Position guys around trunk at approximately two-fifths (2/5) the height of the tree. Anchor guys in ground either to notched stakes or steel rods driven securely into ground with top end three (3) inches below finish grade.
- E. Palm Bracing: Install bracing system at three or more places equally spaced around perimeter of trunk to secure each palm until established unless otherwise indicated.
 - 1. Site-Fabricated Palm-Bracing Method
 - a. Place battens over padding and secure battens in place around trunk perimeter with at least two straps, tightened to prevent displacement. Ensure that straps do not contact trunk.
 - b. Place diagonal braces and cut to length. Secure upper ends of diagonal braces with galvanized nails into battens or into nail-attached blocks on battens. Do not drive nails, screws, or other securing devices into palm trunk; do not penetrate palm trunk in any fashion. Secure lower ends of diagonal braces with stakes driven into ground to prevent outward slippage of braces.
- F. Pruning: Unless otherwise directed by the Landscape Architect do not cut tree leaders. Remove only injured or dead branches from trees, if any. Prune shrubs at the direction of the Landscape Architect.
- G. Remove and replace promptly any plants pruned or mis-formed resulting from improper pruning.
- H. Inspect tree trunks for injury, improper pruning and insect infestation and take corrective measures.

3.10 PLANTING SHRUB AND GROUND COVER BEDS:

- A. Excavate large enough area in loosened soil to install specified container grown plants.

- B. Remove containers without damaging the rootball and set in excavated hole. If the plants are root bound, gently pull roots apart by hand to loosen up the rootball.
- C. Place container grown plant in excavated hole with top of rootball even with final shrub bed elevation.
- D. Backfill rootball with soil from the bed and lightly compact soil around plant to eliminate voids and air pockets.
- E. Mulching: Immediately after planting mulch planting beds with a minimum depth of two (2) inches of bark or three (3) inches of pine straw. Finish edges according to the Drawings. Remove all mulch from foliage of plants.
- F. Watering: Soak entire area immediately after planting. Continue watering thereafter as necessary until Date of Substantial Completion.

3.11 SPACING AND LAYOUT OF SHRUBS AND GROUNDCOVER:

- A. Layout bed outline per the plans.
- B. Layout individual shrubs and groundcovers per the spacing indicated on the plans. Mass plantings are usually laid out by either staggered rows (SR) or even rows. Note that the spacing between rows may be different than the on-center spacing between the plants.
- C. Unless otherwise noted, all shrubs and groundcover shall be given the same spacing from hardscape edges (i.e. sidewalks, roads, or buildings) as their on center spacing (e.g. a shrub labeled as thirty-six inches (36") on center shall have the row closest to the hardscape edge planted thirty-six inches (36") from the hardscape edge.) The Landscape Architect shall approve all plant placement prior to plant material installation.
- D. When two shrub or groundcover beds abut, the on-center spacing between the different plant beds shall be the combined on-center spacing of the two differing plants (e.g. if one plant spaced thirty-six inches (36") on center abut another plant spaced twenty-four inches (24") on center, the on-center spacing between the two different plant beds shall be sixty inches (60"))
- E. Should the site conditions differ from that indicated on the Drawings, notify the Landscape Architect of such conditions with a recommendation for correcting the condition. Obtain approval of method of correction prior to continuing Work.
- F. All plant beds and plants shall be laid out prior to the review of the Landscape Architect.
- G. Should the number of plants not properly match the space allocated for the layout, notify the Landscape Architect prior to installation and obtain an approved, alternate course of action prior to continuing Work.
- H. In cases where the number of too many plants listed on the Drawing become too many for the bed area in the field, maintain the specified spacing. Do not change the spacing in an attempt to use all of the plants listed.
- I. Refer to the Drawings for clarification of spacing details and layout information.

3.12 INSTALLING LAWNS:

A. Sodding New Lawns:

1. Water soil prior to receiving sod. At the time of sod placement soil must be moist but not saturated.
2. Lay sod within twenty-four (24) hours from time of stripping. If not possible, sod may be stored on site up to thirty-six (36) hours after stripping provided sod is properly protected: unstack, unroll and place in shade and keep moist until installation.
3. Do not plant dormant sod.
4. Do not plant sod on frozen ground.
5. Lay sod to form a solid mass with tightly fitted joints. Snugly fit ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.
6. Anchor sod with wood pegs to prevent slippage on slopes equal to or greater than 3:1 and wherever erosion can be anticipated. Lay sod perpendicular to slope direction, with staggered joints.
7. Water sod thoroughly with a fine spray immediately after planting until soil is damp to a depth of four (4) inches. If rainfall is insufficient, keep sodded area moist until grass has securely rooted into the planting area.

B. Reconditioning Existing Lawns:

1. Recondition existing lawn areas damaged by Contractor's operations including storage of materials and equipment and movement of vehicles. Also recondition existing lawn areas where minor regrading is required.
2. Provide fertilizer, seed or sod and soil amendments as specified for new lawns and as required to provide a satisfactorily reconditioned lawn. Provide new topsoil as required to fill low spots and meet new finish grades.
3. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.
4. Remove diseased and unsatisfactory lawn areas; do not bury under soil. Remove topsoil containing foreign materials resulting from Contractor's operations including oil drippings, stone, gravel and other loose building materials.
5. Where substantial lawn remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
6. Thoroughly water newly planted areas immediately after planting. If rainfall is insufficient, lightly water planting area until new grass is established.

3.13 MAINTENANCE:

- A. Begin maintenance immediately after planting.
- B. Maintain trees, shrubs lawns, and other plants until Date of Substantial Completion of the Work.
- C. Maintain trees, shrubs, lawns and other plants by watering, pruning, cultivating, weeding, and re-mulching as required for healthy growth. Restore trench edges around mulch rings and along

bed limes. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.

- D. Maintain lawns by watering, weeding, mowing, repair of eroded areas and re-seeding or re-sodding as necessary to establish a uniform stand of the specified grasses.
- E. Remove all trees, shrubs, ground covers, lawn or other plants which die, turn brown and/or defoliate prior to Date of Substantial Completion from the site. Replace immediately with plant material of the same species, quantity, size and meeting all requirements.

3.14 CLEAN UP AND PROTECTION:

- A. During Landscape Work, keep pavements clean and work area in an orderly condition.
- B. Upon completion of Work, clear grounds of debris, superfluous materials and all equipment. Remove from site to satisfaction of Landscape Architect and Owner.
- C. Protect landscape Work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape Work as directed, at no additional cost to the Owner.
- D. Theft: Contractor is responsible for theft of plant material at the Project site before, during and after planting, until the Date of Substantial Completion of the Work.

3.15 OBSERVATION AND ACCEPTANCE:

- A. Periodic site visits will be made by the Landscape Architect to review the quality and progress of the Work. Work found to be unacceptable must be corrected within five (5) calendar days. Remove rejected plants and materials promptly from the Project.
- B. Upon completion of Work, the Contractor shall notify the Landscape Architect and the Owner at least ten (10) days prior to requested date of site visit for Substantial Completion of all or portions of the Work. Landscape Architect will issue a punch list for work to be corrected. All work on the punch list must be completed within five (5) working days from date of site visit. Where Work does not comply with requirements, replace rejected Work and continue specified maintenance until by Landscape Architect finds work to be acceptable.
- C. If a site visit to verify Substantial Completion has been scheduled and the Landscape Architect arrives at the site and determines that the Landscape Development is not substantially complete, the Contractor shall be responsible for all costs incurred by the Landscape Architect to re-visit the site. Reimbursable expenses include but are not limited to the following: mileage, airfare, consultant's time, parking fee, meals, rental car, etc. All incurred expenses will be deducted from the final contract amount.
- D. Certificate of Substantial Completion will be issued for acceptable Work. If punch list items are issued with the Certificate, they must be corrected within five (5) working days.

- E. One (1) Year Warranty commences on the date of issuance of the Certificate of Substantial Completion. Refer to Section 32 90 00, 1.11 Warranty.

- F. Final Acceptance: One (1) year after Date of Substantial Completion of the Work in total the Landscape Architect and/or the Owner will visit the site to determine Final Acceptance. Upon satisfactory completion of repairs and/or replacements the Landscape Architect and/or the Owner will certify, in writing, the Final Acceptance of the Work. The Final Acceptance letter will serve as evidence that the Contractor's one (1) year warranty obligations have been met.

END OF SECTION 329000

SECTION 33 10 00 - WATER UTILITIES

PART 1 - GENERAL

- A. Under this heading shall be included the complete construction of the Water Distribution System, including utility service, domestic, and fire protection water piping, specialties, services, and valves. The Water Distribution System construction shall satisfy the requirements of the Macon Water Authority. “Standards for the Design and Construction Specifications for Water Distribution and Wastewater Collection” 1984, latest revision, shall be used for this section. The Contractor shall be responsible for securing this document from the Macon Water Authority. The Contractor shall be responsible for complying with all requirements of that document applicable to any portions of the system in the contract.

END OF SECTION 33 10 00

SECTION 33 30 00 - SANITARY SEWERS

PART 1 - GENERAL

- A. Under this heading shall be included the complete construction of the Sanitary Sewer System. The Sanitary Sewer System construction shall satisfy the requirements of the Macon Water Authority. “Standards for the Design and Construction Specifications for Water Distribution and Wastewater Collection” 1984, latest revision, shall be used for this section. The Contractor shall be responsible for securing this document from the Macon Water Authority. The Contractor shall be responsible for complying with all requirements of that document applicable to any portions of the system in the contract.

END OF SECTION 33 30 00

SECTION 33 40 00 - STORM DRAINAGE UTILITIES

PART 1 - GENERAL

- A. Handling and Storage: Handle, transport to the job, unload, store and place pipe in trenches to prevent their being damaged. Any damaged material will be rejected.
- B. Submittals: The Contractor shall furnish to the Engineer, five (5) copies of the manufacturer's certification of materials.
- C. Related Section: Section 31 50 00, Excavation Support, Protection, & Backfill for Utility Systems.

PART 2 - PRODUCTS

- A. Materials: Refer to the Drawings for areas that a specific type of pipe is required. Unless a specific type of pipe is required by the Drawings, the Contractor shall have the option of installing either of the types of pipe listed below.

- 1. Aluminized Steel Type II Corrugated Metal Pipe: The ALUMINIZED Type II STEEL coils shall conform to the applicable requirements of AASHTO M 274 or ASTM A 929.

Aluminized Type II Hydra-cor smooth interior metal pipe shall be manufactured with U-shaped external corrugation conforming to the following dimensions:

<u>Pipe Diameter</u>	<u>Corrugations</u>
15" – 21"	.66" x .90" x 9.68" centers
24" – 30"	.75" x .90" x 9.50" centers
36" and larger	1.0" x .90" x 9.0" centers

The pipe sizes, gauges and corrugations shall be as shown on the project plans.

Culvert pipe shall meet the structural requirements as outlined below (unless specified on the drawings):

<u>Pipe Diameter</u>	<u>Minimum Gauge</u>
15"-54"	16
60"-66"	14

The connecting bands shall be 12" wide for diameters 15" thru 60" and 18" wide for 66" and larger. All culvert pipe and connecting bands shall be fabricated from Aluminized Type II material.

- 2. Reinforced Concrete Pipe: Reinforced concrete pipe (RCP) shall meet the

requirements of ASTM Designation C-76, Class III and the latest revisions thereof. Pipe joints shall be either tongue and groove with mortar joint or "O" ring type joints. Pipe shall meet GA D.O.T. Specifications and shall be stamped by D.O.T.

3. Ductile Iron Pipe: Ductile Iron pipe, pressure class 350 with slip joints. Fittings shall be mechanical joint ductile iron.
4. Down spout Connector Piping Materials: Refer to Drawings for pipe size and locations. Piping and fittings shall conform to the following:

Pipe and fittings shall be Schedule 40 PVC, ADS N12 or pre-approved equal.

Connect to PVC downspout boots and grout downspout into PVC boot.
5. Cast-in-place concrete shall have minimum compressive strength of 3000 psi at 28 days. Slump shall be 3" \pm 1".
6. Brick: Brick for manholes and catch basins shall be first quality, sound, hard burned, perfect shaped brick, presenting a smooth regular shape. Brick shall not absorb more than 16 percent of water by weight when submerged in water for 24 hours, having been in a thoroughly dry state prior to placing in water.
7. Mortar: All cement used in mortar shall conform to ASTM Designation C-150, and the latest revision thereof. All mortar used shall be composed of one part Portland Cement and two parts of fine sand.
8. Cast Iron: Cast iron for manhole frames and covers and catch basin frames and grates, and manhole steps shall conform to the shape and dimensions shown on the Plans, and shall be clean and perfect free from sand and blow holes or other defects. Cast iron shall conform to ASTM Designation A-48-74 for Class No. 20 gray cast iron.
9. Precast Concrete Structures: Precast concrete storm drainage structures shall conform to the requirements of ASTM C-478. Dimensions and reinforcement steel shall be as shown on the details.

PART 3 - EXECUTION

- A. Trenching: Excavate trenches to the line and grade shown on the plans. The minimum width of the trench shall be 12" plus the outside diameter of the pipe. The maximum width shall be 24" plus the outside diameter of the pipe. Machine trenching may be carried to within four inches of the flow line elevation and the remainder of the trench bottom removed by hand. Undercutting will not be permitted except to obtain a stable bottom. Do not open more trench in advance of pipe laying than is possible to use in laying pipe for that day. Backfill all trenches at the end of each day. Protect laid pipe from crushing. If needed, add

additional fill soil over the pipe, if necessary, during the construction work.

Shape the bottom of the trench to the lower 1/3 of the pipe for a firm bed, or lay the pipe on a flat trench bottom and backfill immediately to 1/4 its diameter and tamp in 4" layers against and under the pipe.

- B. Pipe Laying: Lay pipe to line and grade by the use of batter boards or laser. Set batter boards at intervals of 25 feet or less. Begin pipe laying at the lowest flow line elevation and continue toward the highest flow line elevation.
- C. Backfilling: As soon as practicable after the completion of laying and jointing of the pipe, the trench shall be backfilled, and at no time shall be the completed backfilling of the trench be more than 300 feet behind the pipe laying.
- D. Suitable Earth Materials: Soil materials free of roots 1" in diameter and larger, deleterious matter, debris and rocks over 6" in greatest dimension, and with not more than 15% of the rocks or lumps greater than 2-3/8" in their greatest dimension.

Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, backfill the voids remaining after removal of the objects.

When the void is below the subgrade for the storm sewer bedding, use suitable earth materials and compact to at least 95% maximum dry density as determined by the Modified Proctor.

When the void is in the side of the storm sewer trench or open cut, use suitable earth materials and compact to at least 95% maximum dry density as determined by the Modified Proctor.

- E. Lower portion of trenches:

Deposit backfill and bedding material as shown on the plans in layers of 4" maximum thickness, and compact with suitable tampers to the density of the adjacent soil, or grade as specified herein, until there is a cover of not less than 24" over sewers.

Do not damage pipe and pipe coatings in backfilling and bedding operations.

Backfill trenches to the ground surface with selected material approved by the soil engineer.

Reopen trenches which have been improperly backfilled, refill and compact as specified.

- F. Structures: Construct area drains, manholes catch basins, junction boxes, and headwalls to conform to the details shown on the plans. Precast structures shall conform to ASTM C-478 standards and specifications.

After the masonry work and/or concrete work have been completed to elevation, the cast iron frames shall be set in a full bed of mortar and adjusted to the elevation shown on the plans.

- G. Handling and Assembly: Shall be in accordance with NCSPA's (National Corrugated Steel Pipe Association) recommendations.
- H. Installation shall be in accordance with AASHTO Standard Specifications for Highway Bridges, Section 26, Division II or ASTM A 798 and in conformance with the project plans and specifications. If there are any inconsistencies or conflicts, the contractor must bring them to the attention of the Architect.
- I. It is always the contractor's responsibility to follow OSHA guidelines for safe practices.
- J. Construction loads may be higher than final loads. Follow the pipe manufacturer's or NCSPA's guidelines.

END OF SECTION 33 40 00