GENERAL CONDITIONS

Special Provisions

Article 1 DESCRIPTION OF WORK:
This contract provides for the furnishing of all labor and materials together with all work incidental thereto, necessary or required for the Stormwater and Landscape Project Phase II at Wilson Hall Performing Arts Courtyard.

The work includes site preparation and other incidental removals. The new work includes site demolition, fine grading, furnishing and installing new concrete walks, concrete unit pavers, concrete curbs, retaining walls, concrete stairs and ramps, topsoiling, site furnishings, landscaping and seeding, electric and other incidental work.

The above enumeration of the general scheme and principal divisions of the work is not to be construed as including all items and operations necessary for the completion of the work under this project. All work under this project shall be done as shown on the contract drawings and in accordance with these specifications and as directed by the Architect.

Article 2 CONTRACT DRAWINGS:
The general character and typical sections and details are shown on the following drawings entitled:

Stormwater and Landscape Project Phase II at Wilson Hall Performing Arts Courtyard.

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G-002 General Notes
C-101 Existing Conditions Plan
C-102 Site Preparation & Demolition Plan
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SECTION 01731   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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

   A. This Section includes procedural requirements for cutting and patching.

   B. Related Sections include the following:

      1. Division 1 Section "Selective Demolition" for demolition of selected portions of the building.
      2. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

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 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. Products: List products to be used and firms or entities that will perform the Work.
      4. Dates: Indicate when cutting and patching will be performed.
      5. Utility Services and Mechanical/Electrical Systems: 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.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

1. Retaining Walls

2. Precast Concrete and Gabion Seat Walls.

B. 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. Operating elements include the following:

1. Mechanical systems piping and ducts.
2. Control systems.
3. Communication systems.
4. Conveying systems.
5. Electrical wiring systems.

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.

D. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

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. Temporary Support: Provide temporary support of Work to be cut.

B. 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.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to 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 & 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 2 Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Proceed with patching after construction operations requiring cutting are complete.

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.

   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

   a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01731
SECTION 01732

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of concrete retaining walls or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Sections include the following:

1. Division 1 Section "Summary" for use of premises and Owner-occupancy requirements.
2. Division 1 Section "Photographic Documentation" for preconstruction photographs taken before selective demolition operations.
3. Division 1 Section "Cutting and Patching" for cutting and patching procedures.
4. Division 2 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse including the following items:

1. Bike Racks
2. All site furnishings including benches, tables, chairs and trash receptacles.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

1. Concrete pavement to be reused in paving stones and gabion baskets.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
1.4 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1. Coordinate with Owner's historical adviser, who will establish special procedures for removal and salvage.

1.5 SUBMITTALS

A. Qualification Data: For demolition firm & professional engineer.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of proposed dust- and noise-control temporary partitions and means of egress, including for other tenants affected by selective demolition operations.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
7. Means of protection for items to remain and items in path of waste removal from building.

C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

D. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Comply with Division 1 Section "Photographic Documentation." Submit before Work begins.

E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1. Comply with submittal requirements in Division 1 Section "Construction Waste Management."

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.7 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

1. Comply with requirements specified in Division 1 Section "Summary."

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

   a. Condition and depth of exiting concrete pavement.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

E. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
F. Hazardous Materials: Hazardous materials are present in construction to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

G. Storage or sale of removed items or materials on-site is not permitted.

H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

1. Comply with requirements specified in Division 1 Section "Photographic Documentation."
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Division 1 Section "Summary."

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
   a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Division 1 Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 1 Section "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Reuse of Site Elements: Project has been designed to result in end-of-Project rates for reuse of site elements as follows. Do not demolish site elements beyond what is indicated on Drawings without Architect's approval.

1. Concrete pavement

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove and/or reuse for paving stones and gabion fill.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be [recycled,] reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Division 1 Section "Construction Waste Management."

B. Burning: Do not burn demolished materials.
C. Disposal: Transport demolished materials and dispose of at designated spoil areas on Owner's property.

D. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Existing Construction to Be Removed: Excess Concrete that is not being reused and salvaged.

B. Existing Items to Be Removed and Salvaged: Concrete pavement for reuse as paving stones and to fill gabion walls.

C. Existing Items to Be Removed and Reinstalled: Bike Racks.

END OF SECTION 01732
SECTION 310000  SITE WORK

PART I  GENERAL

1.01  DESCRIPTION
A.  These general site work requirements apply to all site work operations.

1.02  QUALITY ASSURANCE
A.  Comply with all applicable local, state and federal requirements regarding materials, methods of work and disposal of excess and waste materials.
B.  Obtain and pay for all required inspections, permits and fees. Provide notices required by governmental authorities.

1.03  DEMOLITION, REMOVAL, CUTTING AND PATCHING
Provide materials, labor, equipment and services necessary to perform work as shown on the drawings, as specified herein or as required by job conditions; scheduling work as required by Contract Documents.

1.04  PROJECT CONDITIONS
A.  Provide adequate means for protection of utilities and services designated to remain. Repair utilities damaged during site work operations at Contractor's expense.
B.  Arrange for disconnection, disconnect and seal or cap all utilities and services designated to be removed or abandoned in place before start of site work operations. Perform all work in accordance with the requirements of the applicable utility company or agency involved.
C.  When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the applicable utility company immediately to obtain procedure directions. Cooperate with the applicable utility company and the Owner in maintaining active services in operation.
D.  Locate, protect and maintain bench marks, monuments, control points and project engineering reference points. Re-establish disturbed or destroyed items at Contractor's expense.
E.  Perform site work operations and the prompt removal of debris and waste materials to assure minimum interference with streets, walks, building entrances and other adjacent facilities and critical services.
F.  Obtain governing authorities written permission when required to close or obstruct street, walks and adjacent facilities. Provide alternate routes around closed or obstructed traffic ways when required by governing authorities.
G. Control dust caused by the work. Dampen surfaces as required. Comply with pollution control regulations of governing authorities.

H. Protect existing buildings, paving and other services or facilities on site and adjacent to the site from damage caused by site work operations. Cost of repair and restoration of damaged items at Contractor's expense.

I. Protect and maintain fences, street lights, utility poles and services, traffic signal control boxes, curb boxes, valves and other services, except items designated for removal. Provide for temporary relocation when required to maintain facilities and services in operation during construction work. Provide for temporary lighting during construction, as necessary.

J. The Owner will occupy the premises and adjacent facilities during the entire period of construction. Perform site work operations to minimize conflicts and to facilitate Owner's use of the premises and conduct of his normal operations. Confirm with Owner the hours of operations and observed holidays.

K. The Contractor shall not remove any greater quantities of existing topsoil, at any given time, than will be replaced promptly. In particular, open excavations are to be avoided over a weekend or period of demobilization.

L. All open excavations shall be secured with metal snow fence stakes and orange plastic safety fence during non-working hours. Caution tape alone is not an acceptable substitute.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment: As selected by Contractor, except as indicated.

PART 3 - EXECUTION

Consult the records and drawings of adjacent work and of existing services and utilities which may affect site work operations.

END OF SECTION
SECTION 311000  SITE CLEARING & TREE PROTECTION

PART I  GENERAL

1.01 DESCRIPTION

A. Clearing Site shall include all labor, materials, equipment, apparatus as stated in the Plans and Specifications and within the intent of the Contract.

B. Pruning of trees & shrubs, air spading tree roots by certified Arborist for de-compacting soil around trees.

C. Preparation of the site includes but is not limited to clearing of whatever nature encountered in the work, except for those items noted to be protected and remain. All disposals shall be outside of the limits of the project and in accordance with the regulations and laws governing solid waste disposal.

D. Clearing Site shall also include final clean up and restoration. This shall include removal of all stored or stockpiled materials placed by the Contractor during the course of the Contract. All areas disturbed by the Contractor shall be restored to the satisfaction of the Landscape Architect prior to final payment being made.

1.02 Materials

A. All materials and equipment utilized by the Contractor for Site Clearing shall be at the Contractor's discretion, except for materials that are used for de-compacting soils round trees - Contractor to use an Air Spade, temporarily protect site features to be preserved and secure open excavations, shall be subject to the approval of the Owner's representative.

1.03 Disposal of Materials

A. All materials accumulated shall be removed on a daily basis from the property except where noted to be saved, and lawfully disposed of in an approved Solid Waste Disposal Facility.

1.04 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Tree Protection techniques to be approved by Landscape Architect.
PART II - EXECUTION

2.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain. Do not remove vegetation until Landscape Architect approves in field selected shrubs to be removed.

C. Protect existing site improvements to remain from damage during construction.

D. Restore damaged improvements to their original condition, as acceptable to Owner.

2.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures in accordance with the State of New Jersey Standards for soil erosion and sediment control to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal as required by the State of New Jersey.

2.3 TREE PROTECTION

A. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed pruning, repairs and to repair damage to trees and shrubs.

B. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

C. Do not store construction materials, debris, or excavated material within fenced area. Do not permit vehicles, equipment, or foot traffic within fenced area. Maintain fenced area free of weeds and trash.

D. Do not excavate within tree protection zones, except for air spading and planting operations.

E. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use an Air Spade, narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

F. Cover exposed roots with burlap and water regularly. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil. Backfill with soil as soon as possible.
G. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Landscape Architect.

H. Prune trees and vegetation indicated to remain, in a manner approved by Landscape Architect.

I. Site features within the limits of construction which do not interfere with the Project and are designated for preservation shall not be removed but shall be protected during the progress of the work.

J. The Contractor's operations shall not extend beyond the limits of disturbance specified on the Plans without written authorization from the Owner's representative. The Contractor will be held accountable for any costs or damages incurred by the Owner as a result of unauthorized disturbance beyond the specified limits.

K. Every necessary precaution shall be taken to prevent damage or injury to existing trees, utility structures, fences, walls, pavements, buildings, signs and other features that are to remain within or adjacent to the Project or abutting properties.

2.5 Tree Removal

A. Grind stumps and remove roots, obstructions, and debris extending to a depth of 8 inches below exposed finish grade.

B. Chip removed branches and dispose of off-site.

C. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

D. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

2.6 Inlet Protection

A. Filter fabric inlet protection will be installed by the Contractor between the drainage structure frame and grate for the purpose of intercepting sediment, thus preventing the entrance of sediment into the storm sewer system. The maintenance, repair, and replacement shall be made by the Contractor as needed and/or as directed by the Owner's representative.

B. Materials: Inlet protection shall be manufactured by Mirafi, type 140N or approved equal.

C. Method of Construction: The perimeter length of the barrier shall be at least four times the perimeter length of the storm sewer inlet and centered on the inlet. The top of the barrier shall be level and uniform for at least this length.

END OF SECTION
SECTION 312000 - EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Preparing subgrades for walks, pavements, turf and grasses, and plants.
   2. Subbase course for asphalt paving.
   3. Excavating and backfilling for utility trenches.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

E. Fill: Soil materials used to raise existing grades.

F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

G. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

H. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 QUALITY ASSURANCE

A. Pre-excitation Conference: Conduct conference at Project site.

1.4 PROJECT CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

B. Do not commence earth moving operations until plant-protection measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.
B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

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

B. Protect and maintain soil erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.4 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of
pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Tree Protection and Trimming."

3.5 SUBGRADE INSPECTION

A. Proof-roll subgrade below pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.6 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.7 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.
B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.9 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under foundations and footings, use satisfactory soil material.

3.10 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.11 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D D 1557:
1. Under pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.
5. For footings and foundations, compact each layer of material at 95 percent.

3.12 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

3.13 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course under pavements and walks as follows:

1. Shape subbase course to required crown elevations and cross-slope grades.
2. Place subbase course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.
3.15 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000
SECTION 321313          CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete sidewalks and ramps.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Action Submittals:
   1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301 unless otherwise indicated.

1.4 MOCK UPS

A. Mockups: Cast mockups of full-size sections of ALL TYPES OF concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
   1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
   4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
   5. Demolish and remove approved mockups from the site when directed by Architect.
   6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
For Exposed Aggregate Concrete Paving: cast horizontally, approximately 72” by 36” by 6 inches deep, to demonstrate the expected range of finish, color, and texture variations. Control joint to be shown on this sample. If accepted the sample may be used as part of the work.

B. Notify Landscape Architect after completion of Field Sample Panels. At direction of Landscape Architect, additional samples may be required if field panels do not meet required color, consistency, formwork and finish specified.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT


B. Rebar: ASTM A 615/A 615M, Grade 60; deformed.

C. Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.2 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

   1. Portland Cement: ASTM C 150, gray portland cement Type I, Type II, or Type III.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.

C. Water: Potable and complying with ASTM C 94/C 94M.


E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
2.3 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.4 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulose fiber in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:

1. Minimum Compressive Strength (28 Days): Class B Design Strength = 4,000 psi.

2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.488.

3. Slump Limit: 4 inches, plus or minus 1 inch.

4. Air Content: 6 percent plus or minus 1.5 percent.

B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

2.6 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
2.7 EXPOSED AGGREGATE

A. Exposed Aggregate Pavement: Delaware River Blend Decorative Gravel. Size: 1/2" - 1" stone.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.
E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, placing, and consolidating concrete.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

D. Screed paving surface with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions.

1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.

2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.7 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in pavement surfaces as follows:
B. FOR MATERIAL – Exposed Aggregate Concrete Pavement:

Aggregate seeding and embedment

1. Immediately after screeding and floating the base slab, sprinkle the aggregate by hand or shovel onto the slab surface until the surface is completely covered with a single yard of stone. Place aggregate as close together as possible to ensure a uniform appearance. After evenly distributing the aggregate, tamp it into the fresh concrete with a wood float, darby, or straight edge. For final embedment, float the surface with a bull float or darby until mortar slightly covers all aggregate particles to about a 1/16-inch depth. A vibrating bull float can be used to speed this process. Be careful during embedment not to mix any of the seeding aggregate with the base concrete. If this happens, the color of the coarse aggregate in the base will show on the finished surface. Continue floating until the moisture on the entire slab surface is uniform and there are no water pockets.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/2 inch.
4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313
SECTION 321400  CONCRETE UNIT PAVERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Concrete brick pavers set in sand on concrete.
   2. Concrete pavers set in sand on concrete.
   3. Concrete pavers on aggregate base.
   4. Edge restraints for unit pavers.

1.2 SUBMITTALS

A. Product Data: For each product indicated.
   B. Samples: Showing the full range of colors, textures, and patterns available for each type of unit paver indicated.
      1. Include Samples of material for joints and accessories involving color selection.

1.3 QUALITY ASSURANCE

A. Build mockups for each form and pattern of unit paver.
   1. Build mockups as shown on Drawings.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or build on frozen subgrade or setting beds.
   B. Weather Limitations for Setting Bed: Install setting bed only when atmospheric temperature is above 40 deg F (4 deg C) and when base is dry.
   C. Cold-Weather Requirements for Mortar and Grout: Heat materials to provide mortar and grout temperatures between 40 and 120 deg F (4 and 49 deg C). Protect unit paver work against freezing for 24 hours after installation.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 COLORS AND TEXTURES

A. Colors and Textures: As selected from manufacturer's full range of standard colors and textures.

2.3 UNIT PAVERS

A. Concrete Pavers: Solid, interlocking paving units, ASTM C 936, made from normal-weight aggregates in sizes and shapes indicated.

   1. Manufacturers:
      a. Techo-Bloc.
      b. Hanover Architectural Products, Inc.
      c. Wassau Tile, Inc.; Terra-Paving Div.

2.4 ACCESSORIES

A. Aluminum Edge Restraints: Extruded-aluminum edging, 3/16 inch (4.8 mm) thick by 4 inches (100 mm) high, with loops pressed from face to receive stakes at 12 inches (300 mm) o.c., and aluminum stakes 12 inches (300 mm) long for each loop.

   1. Manufacturers:
      a. BrickStop Corporation.
      b. Permaloc Corporation.
      c. Sure-loc Aluminum Edging.

B. Cork Joint Filler: Preformed strips complying with ASTM D 1752, Type II.


2.5 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Base: Sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.

B. Geotextile: Woven or nonwoven polyester or polypropylene geotextile, with a permeability rating 10 times greater than that of subgrade soil and an apparent opening size small enough to prevent passage of fines from leveling course into base course.
C. Sand for Leveling Course: Sound, sharp, washed sand complying with gradation requirements of ASTM C 33 for fine aggregate.

D. Sand for Joints: Sharp, washed sand with 100 percent passing No. 16 (1.18-mm) sieve.

2.6 PORTLAND CEMENT-LIME MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C 150, Type I or II.

B. Hydrated Lime: ASTM C 207, Type S.

C. Aggregate: ASTM C 144.

D. Water: Potable.

2.7 POLYMER SAND JOINT

A. Provide Color samples to match pavers, and manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

B. Cut unit pavers with motor-driven masonry saw to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.

   1. For concrete pavers, a block splitter may be used.

C. Joint Pattern: As indicated on plans.

D. Tolerances: Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush nor 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope.

E. Expansion and Control Joints: Provide joint filler as backing for sealant-filled joints where indicated. Install joint filler before setting pavers.

F. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

3.2 AGGREGATE SETTING-BED PAVER APPLICATIONS

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 1557 laboratory density.

B. Proof-roll prepared subgrade and correct deficient areas.
C. Place aggregate base in thickness indicated. Compact by tamping with plate vibrator.

D. Place geotextile over base course, overlapping ends and edges at least 12 inches (300 mm).

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 constant until pavers are set and compacted.

F. Treat leveling base with soil sterilizer to inhibit growth of grass and weeds.

G. Set pavers with a minimum joint width of 1/16 inch (1.6 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.

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.

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.

3.3 SETTING-BED ON CONCRETE SLAB APPLICATIONS

A. Prepare for setting-bed placement by locating 3/4-inch- (19-mm-) deep control bars approximately 11 feet (3.3 m) apart, to serve as guides for striking board. Adjust bars to subgrades required for accurate setting of paving units to finished grades indicated.

B. Place setting bed between control bars. Strike setting bed smooth, firm, even, and not less than 3/4 inch (19 mm) thick. Add fresh material to low, porous spots after each pass of striking board. Carefully fill depressions that remain after removing depth-control bars.

   1. Roll setting bed with power roller to a nominal depth of 3/4 inch (19 mm) while still hot. Adjust thickness as necessary to allow setting unit pavers to grades indicated.

C. Place pavers by hand, maintaining accurate alignment and uniform top surface. Protect newly laid pavers with plywood panels on which workers can stand. If additional leveling of paving is required, and before treating joints, roll paving with power roller.

D. Place unit pavers with hand-tight joints. Fill joints with polymeric sand by sweeping over paved surface until joints are filled.

END OF SECTION 02780
SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.

B. Related Sections:

1. Section 312000 "Earthwork" for aggregate subbase course.
2. New Jersey Department of Transportation (NJDOT) Standard Specifications Division 400 Section 401 “Hot-Mix Asphalt (HMA) Courses”.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

B. Material Certificates: For each paving material, from manufacturer.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by NJDOT.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of NJDOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

C. Standards: All work shall be done in accordance with American Sports Builders Association (A.S.B.A.) guide specifications.

D. Pre-installation Conference: Conduct conference at Project site.
1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Tack Coat: Minimum surface temperature of 60 deg F.
   2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.

B. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: In accordance with NJDOT Standard Specification Section 901.05.01, use coarse aggregate for Hot Mix Asphalt (HMA) that is broken stone conforming to NJDOT Standard Specification Section 901.03.01

B. Fine Aggregate: In accordance with NJDOT Standard Specification Section 901.05.02, for HMA surface course, use fine aggregate that is manufactured stone sand or natural sand.

Manufacture stone sand from aggregates conforming to NJDOT Standard Specification Section 901.03, with not more than 15 percent passing the No. 200 sieve. When the percent passing the No. 200 sieve exceeds 15 percent, blend the stone sand with another approved sand so that the combination contains no more than 15 percent passing the No. 200 sieve, based on stockpile samples theoretically combined. Feed each sand source into the plant through a separate cold feed hopper.

Use natural sand consisting of material composed of predominantly angular particles of quartz or other hard durable minerals conforming to the quality and gradation requirements specified in NJDOT Standard Specification Section Table 901.05.02-1 and Table 901.05.02-2, respectively.

C. Mineral Filler: In accordance with NJDOT Standard Specification Section 901.05.03, use mineral filler for HMA that is free from lumps and foreign materials. Produce mineral filler from broken stone conforming to NJDOT Standard Specification Section 901.03.01, fly ash conforming to NJDOT Standard Specification Section 903.02.03.A, kiln dust from cement manufacture, or baghouse fines from an HMA plant. Produce baghouse fines from a consistent geological source of coarse and fine aggregate.

Ensure that a HMA mixture containing the filler retains 70 percent of its initial strength after an immersion cycle of 14 days when prepared according to AASHTO T 167 and tested according to AASHTO T 165.

Use mineral filler that, when tested according to AASHTO T 37, conforms to the gradation requirements specified in NJDOT Standard Specification Section Table 901.05.03-1.
2.2 ASPHALT MATERIALS

A. Asphalt Binder: In accordance with NJDOT Standard Specification Section 902.01.01, use asphalt binder that conforms to AASHTO M 320, Table 1. Use Grade 64-22, except the ME may direct that an asphalt of softer grade be used when the mixture contains a high percentage of RAP and except where otherwise specified.

B. Tack Coat: In accordance with NJDOT Standard Specification Section 902.01.02 and 902.01.03, use cutback asphalt of the rapid-curing types conforming to AASHTO M 81 and cutback asphalt of the medium-curing types conforming to AASHTO M 82 or emulsified asphalts of the rapid-setting (RS), medium-setting (MS), and slow-setting (SS) types conforming to AASHTO M 140. Use cationic emulsified asphalts of the rapid-setting (CRS), medium-setting (CMS), and slow-setting (CSS) types conforming to AASHTO M 208.

2.3 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes conforming to NJDOT Standard Specification Section 902.02 and complying with the following requirements:

1. Base Course: NJDOT HMA 19M64.
2. Surface Course: NJDOT HMA 9.5M64, 12.5M64 and 12.5H64.

2.4 AUXILIARY MATERIALS

A. Pavement-Marking Paint: Epoxy resin that is a 2 component, 100 percent solids formulation conforming to NJDOT Standard Specification Section 912.03.01.

1. Color: White, yellow, or blue as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Spread mix at minimum temperature of 250 deg F (121 deg C).
   2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to joints.

3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.

3.8 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.
D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Replace and compact hot-mix asphalt where core tests were taken.

C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.10 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 321216
SECTION 321413   SALVAGED CONCRETE PAVING STONES

PART 1 - GENERAL

1.01 WORK INCLUDED: Furnish all labor, materials, equipment, plant tools, and management services necessary for proper and complete execution of all SALVAGED CONCRETE Pavement work. Without restricting the generality of the foregoing, the following items are included:

A. Layout for pavements.
B. Furnishing and installing pavements.
C. Edge Restraints.
D. Submittals.
E. Removal of debris.

1.02 RELATED SECTIONS: Related Sections can include, but may not be limited to:
A. Section 321613 – Cast-In-Place Concrete
B. Section 329300 – Landscape Planting

1.03 REFERENCES

A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing, requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

B. American Society for Testing and Materials (ASTM)
   1. ASTM C136...Standard Test Method for sieve Analysis of Fine and Course Aggregates

1.04 SUBMITTALS/MOCKUP

A. Prepare a mockup of a 10' x 10' area with sufficient number of full size samples of paving stones to represent the units to be used on the project, in the same proportion that they will be furnished for the project. The mockup, if accepted, can be used as part of the plaza.

B. Manufacturers’ product data for all base and joint material, indicating color, size, degradation, and compliance with specified requirements.

Submit a 1 lb. sample and sieve analysis for grading of decomposed granite - 3/8” or 1/4” minus stone fines.—Must be approved by Landscape Architect and owner.

1.05 QUALITY ASSURANCE
A. Requirements given herein may be affected by other related requirements of the Project Specifications. Coordination of Contract requirements is the responsibility of the Contractor.

B. Installer's experience: Minimum 3 years successful experience in installing type of product specified.

1.06 STORAGE AND HANDLING

A. Paving Stones shall be stored in suitable area so as to prevent chipping or breaking.

B. Paving Stones shall be free of loose edges and aggregate, cracking, or flaking. Damaged or unsuitable paver stones shall be culled and removed from the site.

PART 2 - PRODUCTS

2.01 SALVAGED PAVING STONES

A. Salvaged Paving Stones to come from existing concrete walks within the project area that are set for removal to make way for new site improvements.

2.02 SETTING BED

A. Setting Bed

1. Material for Foundation shall consist of 3/4" stone or gravel. Stone shall be clean, hard well burned and free from foreign matter: residue from domestic furnaces will not be accepted.

2. Decomposed Granite -3/8" or 1/4" granite aggregate screenings. Color to be approved by Landscape Architect. Sand and crushed stone shall consist of inert materials that are hard and durable, with stone free from surface coatings and deleterious materials. Gradation requirements shall be as follows:

   Crushed Stone Sieve Analysis Percentage of Weight Passing a Square Mesh Sieve AASHTO T11 -82 and T2782.

2.03 EDGING

A. Permaloc CleanLine Aluminum Edging, Permaloc Corporation, Holland, MI, Phone: 1.800.356.9660 . Size: 1/8" x 5.5" or Equal. Provide a 4'-0" length sample and product data.
PART 3 - EXECUTION

3.01 INSPECTION

A. Examine all work prepared by others to receive work of this Section. Commencement of work will be construed as complete acceptance of preparatory work by others.

B. All Base material to be inspected and approved by Landscape Architect and Engineer prior to installation of paving stones.

3.02 INSTALLATION

A. Compact soil subgrade uniformly in lifts as shown on drawings to at least 95 percent of ASTM D 1557 laboratory density.

B. Proof-roll prepared subgrade and correct deficient areas.

C. Place aggregate base in thickness indicated. Compact by tamping with plate vibrator.

D. Lay paving stones, in pattern shown on the Drawings, AND as directed by the Landscape Architect.

B. If grades must be adjusted, set wood chocks under bars to proper grade. Place setting material between bars and screed and fill until smooth firm surface is obtained. Fill depressions after removal of depth control bars.

C. Adjust thickness as required to ensure proper line and grade of finished installation.

D. Set paving stones, level and true to elevations indicated.

3.03 CLEAN

A. Protect newly laid paving stones with plywood panels; advance panels as work progresses. Maintain protection in good order in all areas subjected to traffic.

B. Clean off all surrounding surfaces and leave area in neat, clean condition.

END OF SECTION
SECTION 321613    CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY
   A. This Section applies to Material Types as indicated on the Materials Plan.
   B. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes for sidewalks and walls.
   C. See Section "Earthwork" for drainage fill under slabs-on-grade.

1.2 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Design Mixtures: For each concrete mixture including dye content.
   C. Shop Drawings: For steel reinforcement and formwork.
   D. Placement schedule.
   E. Samples: For each of the following materials:
      1. Colored Caulk – see Field Sample Panels
      2. 1 lb. samples of Coarse- and fine-aggregate gradations
      3. Form work material – 24”x24” wide
   F. Material certificates.

1.3 QUALITY ASSURANCE
   A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
      1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
   B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
      1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
      2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
      3. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."
C. Pre-installation Conference: Conduct conference at Project site.

D. Field Sample Panels: Before casting architectural concrete as shown on drawings, produce field sample panels of concrete as follows:

- For Wall Mock Up: two (2) samples cast vertically, poured at least two days apart, approximately 36” long by 18” high by 6” inches wide minimum, to demonstrate the approved color, consistency and finish specified. Additional samples may be required until approved color, consistency and finish specified has been met.

E. Notify Landscape Architect after completion of Field Sample Panels. At direction of Landscape Architect, additional samples may be required if field panels do not meet required color, consistency, formwork and finish specified.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Form Ties: Factory-fabricated, removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

   1. Portland Cement: ASTM C 150, Type I

B. Normal-Weight Aggregates: ASTM C 33, graded, 1-inch nominal maximum coarse-aggregate size.

   1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
C. Water: ASTM C 94/C 94M.


E. Color Pigment: NO SUBSTITUTES WILL BE CONSIDERED
   1. FOR THE WALL: No color required.

2.4 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.5 CURING MATERIALS

A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

B. Water: Potable.

2.6 RELATED MATERIALS


B. Colored Caulk: Match concrete color.


2.7 CONCRETE MIXTURES

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, according to ACI 301.
   1. Confirm concrete and color mixture with Landscape Architect.

B. Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.45.
   3. Slump Limit: 5 inches plus or minus 1 inch.
   4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
   5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
2.8 FABRICATING REINFORCEMENT

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

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Form work to be performed by Master Carpenter or similar tradesmen with high skill-level and significant amount of experience working with site-specific forms.

B. Form work on the visible wall face to be constructed in strict adherence to layout as per Dimension Plan and Landscape Architect’s direction. Extreme care in crafting formwork required to provide polished, smooth, uniform, aesthetically-pleasing surface across form work.

C. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

D. Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch.

F. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

G. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
3.2 EMBEDDED ITEMS

A. See Section “Site Furnishings” for attached items. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Landscape Architect.

1. Continue reinforcement across construction joints, unless otherwise indicated.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated on Jointing Plan. Construct contraction joints for a depth equal to at least [one-fourth] of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/4 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Expansion Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as wall, plaza, banding, and other locations as indicated on Layout Plans. Caulk top 1” of joint with color-coordinated caulk.
3.6 CONCRETE PLACEMENT

A. Landscape Architect to inspect forms before placing concrete.

B. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

E. Cold-Weather Placement: Comply with ACI 306.1.

F. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

FOR MATERIAL – CONCRETE WALL

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete wall surfaces exposed to public view.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for 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, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.9 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Landscape Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.10 ANTI-GRAFFITI COATING

A. Wearlon 711/722 applied per manufacturer’s instructions.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

1. Testing Services: Tests shall be performed according to ACI 301.

END OF SECTION 321613
SECTION 324500 - PRECAST ARCHITECTURAL CONCRETE

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. Architectural precast concrete units.
   B. Related Requirements:
      1. Section 033000 "Cast-in-Place Concrete" for installing connection anchors in concrete.

1.3 DEFINITIONS
   A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.4 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site

1.5 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
   C. Shop Drawings:
      1. Detail fabrication and installation of architectural precast concrete units.
      2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
      3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
      4. Indicate details at corners.
      5. Indicate separate face and backup mixture locations and thicknesses.
      6. Indicate type, size, and length of welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
8. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
9. Include plans and elevations showing unit location and sequence of erection for special conditions.
10. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
11. Indicate relationship of architectural precast concrete units to adjacent materials.
12. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

D. Samples: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

SAMPLES

1. Submit 1 sample, 6" x 6" size for each color.
   a. Color to be selected from Wausau Tile Site Furnishings color chart.
   b. Sample to be submitted for color and texture.
   c. Match existing or architect’s sample.

2. Submit copy of Quality Assurance and Procedure Program.
   a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.

E. Delegated-Design Submittal: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Show governing panel types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator & testing agency.

B. Welding certificates.

C. Material Certificates: For the following items:
   1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
5. Structural-steel shapes and hollow structural sections.

D. Material Test Reports: For aggregates.

E. Preconstruction test reports.

F. Source quality-control test reports.

G. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE


B. Installer Qualifications: A precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project in same category as this Project and who can produce an Erectors' Post-Audit Declaration.

C. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.


D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."


G. Sample Units: After sample approval and before fabricating architectural precast concrete units, produce a minimum of two sample units approximately 24” square in area of each surface for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample units.

1. Locate units where indicated or, if not indicated, as directed by Architect.
2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.

4. Demolish and remove sample units when directed.

1.8 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground or other rehandling.

B. Support units during shipment on nonstaining shock-absorbing material.

C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

F. Lift and support units only at designated points indicated on Shop Drawings.

1.10 WARRANTY

A. Manufacturer/Installer shall warrant installed system for a period of 2 years from date of substantial completion against failure of workmanship and materials.

1.11 REFERENCES

A. American Society for Testing and Materials (ASTM)

B. ASTM C-150

C. ASTM C-33

D. ASTM C-260

E. ASTM C-494

F. ASTM C-128
G. ASTM C-31
H. Precast/Prestressed Concrete Institute (PCI) C. American Concrete Institute (ACI)
I. ACI-318

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Wausau Tile, Inc. PO Box 1520 Wausau, WI 54402-1520 (715) 359-312

Basis of Design: Drawings and specifications are based on manufacturer's proprietary literature from Wausau Tile, Inc. Other manufacturers shall comply with minimum levels of material specifications and detailing indicated.

2.2 MATERIALS

A. Portland Cement: ASTM C-150 specifications for Portland Cement. B. Aggregates: All aggregates to meet ASTM C-33 specifications
B. Cleaned and properly graded to size. Aggregates shall be blended to meet individual project requirements. Coloring: Pigments used shall be inorganic, resistant to alkalinity and used per manufacturer's recommendations.
C. Reinforcement and Hardware: To conform with ACI and manufacturer's design.
D. Reinforce precast with deformed rods or wire, or both, as recommended by precast concrete manufacturer.
E. E. Caulks and Sealants
F. Polyurethane or acrylic sealant
G. Color to be selected by architect from standard color pallet.
H. Sealer: Colorless, pure acrylic water-repellent penetrating sealer. Sealer to maintain natural look of concrete surface with no glaze or gloss, darkening or color change.
I. MANUFACTURED UNITS A. Sizing Tolerances: All units to conform to shop drawings, with a 1/8" tolerance in dimension.
J. Precast Surfaces and Edges: All exposed edges to have minimum 1/8" chamfer to prevent chipping.
K. Finished surfaces to match approved control sample.
L. All precast concrete finished surfaces to be sealed with a sealer approved by manufacturer.

2.3 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

2.4 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, deformed.

B. Galvanized Reinforcing Bars: ASTM A 615/A 615M.

C. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M.

D. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, ASTM A 706/A 706M, deformed bars, assembled with clips.

2.5 CONCRETE MATERIALS

2.6 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.
2.7  FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 10 inches (250 mm) in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.

2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.

3. Place reinforcing steel and prestressing strands to maintain at least 3/4-inch (19-mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches (38 mm) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

G. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.

1. Delay detensioning or post-tensioning of precast, prestressed architectural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete unit.
2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.

H. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
1. Place backup concrete mixture to ensure bond with face-mixture concrete.

K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.
1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.

L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

M. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.

N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

O. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.8 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
1. Alignment of Mortar Joints:
   a. Jog in Alignment: 1/8 inch (3 mm).
   b. Alignment with Panel Centerline: Plus or minus 1/8 inch (3 mm).

2. Variation in Width of Exposed Mortar Joints: Plus or minus 1/8 inch (3 mm).

3. Tipping of Individual Thin Bricks from the Panel Plane of Exposed Thin-Brick Surface: Plus 0 inch (0 mm); minus 1/4 inch (6 mm) less than or equal to depth of form liner joint.

4. Exposed Thin-Brick Surface Parallel to Primary Control Surface of Panel: Plus 1/4 inch (6 mm); minus 1/8 inch (3 mm).

5. Individual Thin-Brick Step in Face from Panel Plane of Exposed Thin-Brick Surface: Plus 0 inch (0 mm); minus 1/4 inch (6 mm) less than or equal to depth of form liner joint.

B. Stone Veneer-Faced Architectural Precast Concrete Units:

1. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated: Plus or minus 1/4 inch (6 mm).

2. Variation in Joint Width: 1/8 inch in 36 inches (3 mm in 900 mm) or a quarter of nominal joint width, whichever is less.

3. Variation in Plane between Adjacent Stone Units (Lipping): 1/16-inch (1.5-mm) difference between planes of adjacent units.

2.9 FINISHES

A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved sample units and as follows:

1. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.

2. As-Cast Surface Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb.

3. Textured-Surface Finish: Impart by form liners or inserts.

4. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.

5. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.

B. Finish exposed surfaces of architectural precast concrete units to match face-surface finish.

C. Finish exposed surfaces of architectural precast concrete units with smooth, steel-trowel finish.

D. Finish unexposed surfaces of architectural precast concrete units with as cast finish.

2.10 SOURCE QUALITY CONTROL

B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator’s quality-control and testing methods.

1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

C. Strength of precast concrete units is considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements for concrete strength.

D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M and ACI 318 (ACI 318M).

1. A minimum of three representative cores shall be taken from units of suspect strength, from locations directed by Architect.
2. Test cores in an air-dry condition.
3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
4. Report test results in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports include the following:
   a. Project identification name and number.
   b. Date when tests were performed.
   c. Name of precast concrete fabricator.
   d. Name of concrete testing agency.
   e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

F. Defective Units: Discard and replace recast architectural concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect’s approval. Architect reserves the right to reject precast units that do not match approved samples, sample units, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.

B. Do not install precast concrete units until supporting cast-in-place concrete has attained minimum allowable design compressive strength and supporting steel or other structure is structurally ready to receive loads from precast concrete units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.

1. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch (19 mm).

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- (0.1-mm-) thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780/A 780M.
5. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:
   d. Direct-Tension Control Bolt: ASTM F 1852.
3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated with inspection agency.

F. Grouting or Dry-Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

B. Erect architectural precast concrete units level, plumb, square, and in alignment, without exceeding the following noncumulative erection tolerances:

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch (13 mm).
2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch (13 mm).
3. Top Elevation from Nominal Top Elevation: As follows:
   a. Exposed Individual Panel: Plus or minus 1/4 inch (6 mm).
   b. Non-Exposed Individual Panel: Plus or minus 1/2 inch (13 mm).
   c. Exposed Panel Relative to Adjacent Panel: 1/4 inch (6 mm).
   d. Non-Exposed Panel Relative to Adjacent Panel: 1/2 inch (13 mm).
4. Support Elevation from Nominal Support Elevation: As follows:
   a. Maximum Low: 1/2 inch (13 mm).
   b. Maximum High: 1/4 inch (6 mm).
5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet (30 m): 1 inch (25 mm).
6. Plumb in Any 10 Feet (3 m) of Element Height: 1/4 inch (6 mm).
8. Joint Width (Governed by Joint Taper): Plus or minus 1/4 inch (6 mm).
10. Joint Taper in 10 Feet (3 m): 1/4 inch (6 mm).
12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch (6 mm).
13. Opening Height between Spandrels: Plus or minus 1/4 inch (6 mm).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
B. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and ASTM E1444. High-strength bolted connections are subject to inspections.
C. Testing agency will report test results promptly and in writing to Contractor and Architect.
D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
E. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.
B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).
C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.
D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.6 CLEANING

A. Clean surfaces of precast concrete units exposed to view.
B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034500
SECTION 321813  SYNTHETIC GRASS SURFACING

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 synthetic grass surfacing and associated components
      1. Turf Fabric
      2. Foam Shock-Attenuation Pad
      3. Geotextile
      4. Welded wire forms
      5. Infill Sand
      6. Concrete Sand
      7. Stone Base for Berm
      8. Wood Stakes
   B. Related Requirements:
      1. Section 312000 "Earth Moving" for preparation, compaction, and grading of granular base.

1.3 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at project site: 2000 Catharine Street, Philadelphia PA 19146, including but not limited to the following participants
      1. General Contractor
      2. Landscape Contractor
      3. Landscape Architect

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: For synthetic grass surfacing.
1. Include sections and details.
2. Show locations of seams and method of seaming.
3. Show location of anchor attachments.
4. Show layout of berm steps

C. Samples: For the following:
   1. Turf Fabric
   2. Foam Shock-Attenuation Pad
   3. Geotextile
   4. Welded wire forms
   5. Infill Sand
   6. Concrete sand
   7. Stone Base for Berm: 1 lb pound each of all types specified

1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For Installer.
   B. Product Test Reports: For each synthetic grass surfacing assembly.
   C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For synthetic grass surfacing, including maintenance cleaning instructions, to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Turf Fabric: Minimum of 300 sq. ft. for each type indicated.
      2. One new set of maintenance tools, of type recommended by synthetic grass surfacing manufacturer for installation.

1.8 QUALITY ASSURANCE
   A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
      1. Provide images of past construction work similar to work to be performed.
1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials in location and manner to allow installation of synthetic grass surfacing without excess disturbance of granular base.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace synthetic grass surfacing that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Deterioration and excessive wear.
   b. Deterioration from UV light.
   c. Excessive loss of shock attenuation.
   d. Seam separation, including game lines and markings.

2. Warranty Period: Per Manufacturer

PART 2 - PRODUCTS

2.1 SYNTHETIC GRASS SURFACING

A. Turf Fabric: Complete surfacing system, consisting of synthetic yarns bound to water-permeable backing and infill indicated.

1. Manufacturer: Synthetic Turf International

2. Subject to compliance with requirements, provide the following product:

   a. PL901 SoftLawn Kentucky Blue, available from the following local supplier/installer:
      1) Joe Ehrenreich at Young’s Landscape, PO Box 298 Moorestown, NJ 08057, (609) 654-5441

   b. No Substitutions unless approved by Landscape Architect

2.2 ASSOCIATED MATERIALS

A. Foam Shock-Attenuation Pad: Porous composite consisting of rubber granules bound with urethane adhesive, 5 mm thick; dimpled. Provide shock-attenuation pad with permeability sufficient to meet synthetic grass surfacing requirements.

B. Geotextile:
   1. non-woven filter fabric to wrap outside of welded wire forms
   2. woven filter fabric behind welded wire forms

SYNTHETIC GRASS SURFACING
C. Welded Wire Forms per approval of Geotechnical Engineer

D. Sand Infill: Uniformly sized silica sand free of silts, clays, and contaminants, and of subangular or rounder shape according to ASTM F 1632; mesh size as recommended by synthetic grass surfacing manufacturer.

E. Concrete Sand per approval of Geotechnical Engineer

F. Stone Base for Berm: as shown on Drawings
   1. #57 stone aggregate to meet AASHTO M 43
   2. #67 stone aggregate to meet AASHTO M 43
   3. #8 stone aggregate to meet AASHTO M 43

G. Wood Stakes: 12”x1”x1” square, hardwood stakes per approval of Geotechnical Engineer

H. Seam Adhesive: One- or two-part urethane, recommended or approved by synthetic grass surfacing manufacturer, and suitable for ambient conditions at time of installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine base and other conditions, with Installer present, for compliance with requirements for installation tolerances, permeability, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Avoid disturbance of base during installation of shock-attenuation pad and turf fabric.

B. Shock-Attenuation Pad Installation: Roll out pad and allow to relax a minimum of six hours prior to final fit and trim. Stagger head seams between adjacent rows. Fit seams snugly without stretching or forcing.

C. Roll out turf fabric and allow to relax at least four hours prior to seaming.

D. Provide seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Attach turf fabric to perimeter restraint system as recommended by the manufacturer.

E. Repair loose seams and bubbles formed due to expansion of turf fabric prior to installation of infill.

F. Seaming Method: per manufacturer’s recommendations.

G. Evenly broadcast and groom infill by machine in proportions and depth after settling as recommended by the manufacturer, and to meet indicated performance requirements. Rake fibers trapped by infill to surface.
3.3 FIELD QUALITY CONTROL

A. Mock Ups for each layer of materials for inspection and review by Landscape Architect for adherence to form as shown on Drawings.

B. Construct an area of the berm beginning from one end to include steps for Landscape Architect to review and approval.

1. For welded wire forms: Construct part of the arc of lowest step and one end of steps where it transitions to meet berm grades. Approved mock Up may be used as part of finished work. Approval is required before moving to Stone Layers.

2. For Stone Layers: Construct an area an with filter fabric and stone at least 15’x8’ that demonstrates the layers of graded stone and two types of filter fabric. Approved mock Up may be used as part of finished work. Approval is required before moving to Synthetic Grass Surfacing layer.

3. For final Synthetic Grass Surfacing: Construct an area with synthetic turf layers and foam pad at least 15’x8’ that demonstrates steps and slope of berm. Approved mock Up may be used as part of finished work.

3.4 DEMONSTRATION

A. Train Owner’s maintenance personnel in proper maintenance procedures for synthetic grass surfacing.

END OF SECTION 321813
SECTION 328400 IRRIGATION

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS
   A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.02 WORK INCLUDED
   A. The Work of this Section shall include the furnishing of all labor, materials, equipment and services necessary to complete the irrigation system as shown on the drawings and specified herein, including, but not necessarily limited to, the following:

   1. Water supply stubs to be provided for Irrigation Contractor’s point of connection as indicated on the plans.
   2. Excavation of all trenches and proper backfilling after irrigation lines are installed.
   3. Furnishing and installing an automatic irrigation system including controller, piping, sprinkler heads, dripperline, fittings, quick coupling valves, gate valves, drain valves, backflow preventer any accessories necessary to complete the installation as outlined in the Contract Documents.
   4. All material to be incorporated in the work, all labor performed, and all appliances, tools and methods shall be subject to the inspection and approval or rejection of the Landscape Architect.
   5. The Contractor shall provide all sleeves necessary for irrigation piping. Sleeves shall be required when piping crosses paths, driveways and other paved surfaces.
   6. All material must be as specified. Any alternate manufacturers must be submitted for approval before being substituted as an equal.
   7. The Contractor shall verify any existing site utility locations in the area of his work. Any damage to existing utilities during construction will be repaired at the Contractor’s expense.
   8. The Contractor shall test and make operative the irrigation system. The Contractor is responsible for proper water coverage in all watering areas, and in accordance with the intent of the Plans.
   9. Final acceptance of the irrigation system is subject to the inspection and approval of the Landscape Architect.
10. The contractor shall provide the owner with complete instruction and an owners manual. The owners manual shall include all parts manuals and instruction sheets of the products installed. The manual shall be index tabbed with an irrigation “as built” drawing for easy reference.

1.03 RELATED WORK

1. SECTION 329200 Lawns and Grasses
2. SECTION Trees, Shrubs, Groundcover and Planting Soil

1.04 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacturing irrigation systems materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer’s Qualifications: The contractor must carry a New Jersey license to install irrigation in the state. Furthermore, firms must have successfully completed execution of a minimum of five (5) contracts involving the installation of irrigation and piping work similar in size and scope to that required for this project. Such experience should be able to be demonstrated through references.

C. Codes and Standards:
   1. Comply with all applicable state and local ordinances and codes.
   2. All materials and work shall meet the requirements of the A.W.W.A., A.S.S.E. and the USC Foundation for Cross Connection Control.

1.05 FEES, PERMITS AND CERTIFICATES

A. The Contractor shall obtain all permits, inspections, and approvals as required by all authorities having jurisdiction. All fees and costs of any nature whatsoever incidental to these permits, inspections and approvals shall be assumed and paid for by the Contractor.

1.06 UTILITIES AND SITE PROTECTION

A. Existing Utilities:

Owner shall supply site utility and all pertinent background information relating to the existing conditions of the site to the Contractor.

Contractor shall be thoroughly acquainted with all site conditions. Should utilities not shown on the plans be found during excavations, contractor shall promptly notify the owner’s representative for instructions as to further action. Failure to do so will make Contractor liable for any and all damage thereto arising from his/her operations subsequent to discovery of such utilities not shown on plan.
Contractor shall make necessary adjustments in the layout as may be required to connect the existing stubouts. Should such stubs not be located exactly as shown, Contractor may be required to work around existing conditions at no cost to the Owner.

1.07 DRAWINGS, SPECIFICATIONS AND DETAIL SHEETS

A. Scale and Dimensions:

1. Consider drawings and specifications as being compatible and therefore work called for by one and not the other shall be furnished and installed as though called for by both. When discrepancies exist between scale and dimension or between the work to be accomplished by each trade, they shall be called to the Landscape Architect’s attention immediately before work is to proceed.

2. Where diagrams have been made to show piping connections, etc., Contractor is cautioned that these diagrams must not be used for obtaining lineal runs or number and type of fittings. Irrigation designs are schematic in nature.

All measurements shall be verified at the site. Do not scale measurements from drawings.

1.08 CODES AND STANDARDS

A. All materials, installation and workmanship shall comply with all applicable local, county, state and federal codes, specifications, ordinances, utility company regulations, and manufacturers and industry standards.

In case of differences in building codes, specifications, state laws, local ordinances, industry standards, utility company regulations and the contract documents, the most stringent shall govern. The Contractor shall promptly notify the Landscape Architect in writing of any such difference. Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards or utility company regulations, he shall bear all costs arising in correcting these deficiencies.

C. In addition to the local, county and state ordinances, as well as the utility company regulations, the following industry standards and codes will be referred to:

1. ANSI  American National Standards Institute
2. AWWA  American Waterworks Associates
3. ASTM  American Society for Testing Materials
4. NSF  National Sanitation Foundation

1.09 SUBMITTALS
A. Shop Drawings: Contractor shall be responsible for providing shop drawings of recommended irrigation design based on the proposed planting design. Quantity, type and location of all pipes, fittings, valves, etc. shall be indicated based on the specifications herein.

B. All materials of every description are to be furnished exactly as specified and shall be new and of the best quality and grade obtainable. Contractor, before beginning work herein specified shall submit to the Landscape Architect for approval: Manufacturer’s technical product data and installation instructions; and Three (3) sets of material submittals, bound and indexed for all irrigation system materials and products to be furnished. If Contractor requires more than one (1) copy of submittal returned, the initial submittal shall be increased by the appropriate number. Material submittals shall include, but are not limited to, the following:

1. Main Lines and Lateral Lines
2. Emitter Lines and Spray Heads
3. Valves (including, but not limited to, Gate/Drain, Quick Coupling, Remote Control, Air Release, Flush, and Pressure Regulation Valves)
4. Filters
5. Pipes and Fittings
6. Access Boxes
7. Automatic Controller
8. Backflow Preventers
9. Cement and Primer
10. Control Wire
11. Sleeves
12. Drains

B. All materials which are to be used must be submitted for approval before work begins, whether they are as specified on the plan and written specifications or a substitution for materials specified.

C. Record Drawings: During the course of the installation, the Contractor shall be responsible for recording all changes made during installation. The Owner will supply one reproducible copy of the Irrigation Plan for this purpose. Contractor shall submit reproducible copy plus six (6) sets of As-Built Drawings with details for approval. Drawings submitted must show Contractor’s title block with name, address, scale and project name. If contractor requires more than one (1) copy of submittal returned, the initial submittal shall be increased by the appropriate number. Once the As-Built Drawings have been approved, they will be used as a permanent record of the installation.

D. Maintenance Data: Submit maintenance data and parts lists for irrigation system materials and products in binder form. Include these data, product data, shop drawings and record drawings in a maintenance manual.

1.10 DELIVERY, STORAGE AND HANDLING OF MATERIALS

A. Delivery and Storage: Inspect all materials delivered to the site for damage. Unload and store with the minimum of handling. Do not store materials directly
on the ground. Keep inside of pipes and fittings free of dirt and debris. Protect pipe and fittings from exposure to direct sunlight over extended periods.

B. Handling: Handle materials in such a manner as to ensure delivery to the trench in sound undamaged condition.

1.11 PIPING ARRANGEMENT

A. Suggestions for changes in location of piping, etc., by the Contractor shall be submitted to Landscape Architect for approval before proceeding with the work, with written assurance that such changes will not cause any extra cost on their part or the part of any other Contractor, and will not cause any alteration of design requirements.

1.12 GUARANTEE

A. Guarantee all work done for two (2) years from date of acceptance against all defects in material, equipment and workmanship. Guarantee shall cover repair of damage to any part of the premise resulting from leaks, or other defects in material, equipment and workmanship to the satisfaction of the Landscape Architect. Repairs, if required, shall be done promptly, at no cost to the Owner.

Guarantee will include spring start-up and winterizing of system within two (2) years of time and development of approved water application schedule. Winter damage due to improper winterization is the sole responsibility of the Contractor.

All repairs and servicing required under the guarantee period shall be made under the observation of the Facilities maintenance crew to help train them in the proper operation and repair of the system.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS – IRRIGATION EQUIPMENT

A. Manufacturer: Submit to compliance with requirements, provide products as follows:

1. NETAFIM USA Techline, Or approved equal. (800) 777-6541.

2.02 MATERIALS

A. General:
1. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.

All materials throughout the system shall be new and in perfect condition.

B. Piping: Provide pipes of one of the following materials of weight/class indicated. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.

1. Polyvinyl Chloride (PVC): Sized as shown on drawings. All PVC pipe shall be continuously and permanently marked with manufacturer's name, material and schedule or type. Pipe shall conform to U.S. Department of Commerce Commercial Standard CS 256-63, or latest revision. All PVC pipe shall be SDR 21.

2. Fittings: Schedule 40, polyvinyl chloride (PVC) weight as manufactured by Dura or approved equal. Solvent weld or insert fittings are acceptable. No saddle tube clamping or fittings shall be used. Fittings to conform to ASTM D-2466.

C. Valves:

1. Gate/Drain Valves: Shall be sized for mains. The valves shall be all bronze solid wedge, screw bonnet rated at 200 WOG.

2. Quick Coupling Valves: Shall be Rain Bird Sprinkler Manufacturing Corporation 1" brass with locking top, key and hose swivel, located on main lines.

3. Remote Control Valves: Shall be Rain Bird Sprinkler Manufacturing Corporation PGA – PRS Series Valves: The electric remote control valve shall be a normally closed 24 VAC 50/60 Hz (cycles/second) solenoid actuated globe/angle pattern design. The valve body and bonnet shall be constructed of high impact, weather resistant PVC with stainless steel screws.

The valve shall have manual open/close control (internal bleed) for manually opening and closing the valve without electrically energizing the solenoid. The valve's internal bleed shall prevent flooding of the valve box.

The valve shall house a fully-encapsulated, one-piece solenoid. The solenoid shall have a captured plunger with a removable retainer for easy servicing, and a leverage handle for easy turning. This 24 VAC 50/60 Hz solenoid shall open with 19.6 VAC minimum at 150 psi (10.35 bar). At 24 VAC, average inrush current shall not exceed 0.41 amps. Average holding current shall not exceed 0.14 amps.
The valve shall have a flow control stem for accurate manual regulation and/or shut off of outlet flow. The valve must open or close in less than 1 minute at 150 PSI (10,35 bar), and less than 30 seconds at 20 PSI (1,38 bar).

valve construction shall provide for all internal parts to be removable from the top of the valve without disturbing the valve installation. The body shall have a removable 0-ringed plug for installation in either globe or angle configuration.

The valve shall be as manufactured by Rain Bird Corporation, Azusa, California.

Optional Feature Specifications

PRS-D Pressure Regulating Module: 100PGA-PRS-D, 150PGA-PRS-D, 200PGA-PRS-D

As so indicated on the design, the electric remote control valve shall have a pressure regulating module (PRS-D) capable of regulating outlet pressure between 15 and 100 psi (±3 psi) (1,04 and 6,90 bar (±0,21 bar).

The PRS-D module shall have an adjusting knob for setting pressure and Schrader valve connection for monitoring pressure. The pressure shall be adjustable from the PRS-D when the valve is internally manually bled or electrically activated.

4. Drip Zone Valve Kit: Shall be Rain Bird High Flow Commercial Control Zone Kit for dripline zones with flows from 15.0 to 40.0 GPM (56,8 to 151,4 lpm), including Rain Bird PESB valve and two parallel Rain Bird pressure regulating quick-check basket filters.
   • XCZ-150-PRB-COM [1 1/2" (38 mm) Rain Bird PESB valve, and two 1" (25 mm) PRB-QKCHK-100 pressure regulating check basket filters]
   • PESB valve assembly component specifications must include:
   • PESB valve body and bonnet constructed of durable glass-filled nylon, stainless steel and other chemical/UV resistant materials
   • Diaphragm constructed of a durable Buna-N rubber material reinforced with nylon
   • One-piece solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
   • External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
   • Inlet pressure rating: 20 to 200 PSI (1,4 to 13,8 bar)
   • Female threaded inlet and outlet connections
   • Pressure Regulating Quick Check Basket Filter combines filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. Pressure regulating basket filter component specifications must include:
   • Basket style body and jar-top cap constructed of heavy-duty glass-filled, UV-resistant polypropylene, with 150 PSI (10,3 bar) operating pressure rating. Maximum dimensions of filter body; Height: 6 1/2" (16,5 cm), Length: 6 1/2" (16,5 cm), Width: 3 1/2" (8,9 cm)
   • Indicator incorporated into filter cap that changes color from green to red during operation when the filter element requires cleaning.
• Standard 200 mesh (75 micron) filter screen constructed of stainless steel attached to propylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.

• Normally-open in-line pressure regulating device, constructed of durable, UV resistant non-corrosive material able to accommodate an inlet pressure rating of not less than 150 PSI (10.3 bar), with preset outlet pressure of approximately 40 PSI (2.8 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure. Male threaded 1” (25 mm) inlet and outlet connections

D. Spray Heads: Shall be Rain Bird® 1800™ Series Spray Body designed to provide uniform coverage over entire area of spray shown on drawings at available water pressure or as follows:

• Rain Bird® 1806-SAM-PRS Spray Body for shrub or small turf areas (2.5-24 feet (0.8-7.3m)) spacing: maximum 70 psi (4.8 bar).

• Pop-Up spray body for shrub or small turf areas (2.5-24 feet (0.8-7.3m)) spacing: maximum 70 psi (4.8 bar). Irrigation spray body specifications include but are not limited to:
  • The spray body, stem, nozzle, and screen shall be constructed of heavy-duty and ultra-violet resistant plastic.
  • Shall have a heavy-duty strong stainless steel retract spring for positive pop-down.
  • Pressure-activated, co-molded soft elastomer wiper seal ensures a positive seal without excess “flow-by” which enables more heads to be installed on the same valve.
  • Precision controlled flush at pop-down to clear debris from the unit, to assure positive stem retraction in all soil types.
  • Ratchet mechanism to allow easy nozzle pattern alignment without tools.
  • Shall include a Seal-A-Matic™ check valve to prevent low head drainage of up to 14 feet (4.3 m); 6 psi (0.4 bar).
  • Shall include “SAM” marking printed on the top of the cap.
  • Sealing device shall be an integral part of the pop-up stem.
  • Shall be removable through the top of the spray body.
  • Shall seal against the downstream end of bottom inlet.
  • Shall create no more than 1 psi (.07 bar) pressure drop at the maximum rated flow.
  • Shall include a rubber Seal-A-Matic™ seal washer.
  • Includes a stronger retract spring to accommodate elevations changes up to 14 feet (4.3 m).
  • Prevents drainage from spray bodies at lower elevations.
  • Retains water in lateral pipes to reduce the wear on system components by minimizing water hammer during start-up.
  • Shall include a 30 psi (2.0 bar) pressure regulating device to prevent high pressure fogging to the nozzle stream.
  • Shall include “PRS” marking printed on the top of the cap.
• Pressure regulating device shall be an integral part of the pop-up stem.
• Pressure regulating device shall include a dust shroud cap separate from the flow tube to protect the pressure regulating device o-rings from contamination.
• Pressure regulating device shall regulate nozzle pressure to 30 psi (2.0 bar) regardless of ascending, descending or fluctuating inlet pressure.
• Shall be removable through the top of the spray body.
• The device shall regulate the nozzle pressure to 30 psi (2.0 bar) for inlet pressures ranging from 35 to 100 psi (2.4 to 6.9 bar).
• Pressure below 35 psi (2.4 bar) shall not exceed a pressure loss of 6 psi (0.4 bar).
• Prevents high pressure nozzle operation that causes water waste, overthow, and detrimental performance.
• 9 3/8” (23.8 cm) body height; 6” (15.2 cm) pop-up height.
• Operating range of 2.5 to 24 feet (0.8 to 7.3m).
• Operating pressure range of 15 to 70 psi (1.0 to 4.8 bar).
• Exposed surface diameter shall measure 2 1/4” (5.7 cm).
• Flow by rating of 0 at 8 psi (0.6 bar) or greater, 0.1 gpm (0.02 m³/h; 0.06 l/s) otherwise.
• Shall include ½” (15/21) NPT female threaded bottom inlet.
• All spray body components shall be removable from the top without special tools in order to provide quick and easy flushing and maintenance of the sprinkler.
• The spray body shall have a pre-installed Pop-Top™ Flush Plug.
• The plug shall prevent debris from clogging the sprinkler during installation and allow for the system to be flushed before nozzling.
• The plug shall be bright orange in color and constructed of polypropylene material.
• Shall include a five-year trade warranty.
• Shall be manufactured by Rain Bird® Corporation, Azusa, California.

2. Root Watering System; Shall Be Rain Bird® With contractor installed manual shut off valve. **RWS-B-C-1404**: Root Watering System with 36” (91.4 cm) tube, 1 gpm (3.8 l/m) bubbler & check valve on riser, 4” (10.2 cm) grate, versatile swing assembly with 1/2” (15/21) M NPT inlet.

E. Netafim Techline Sub Surface Drip

Continuous Self-Flushing, Pressure-Compensating Dripperline: Techline tubing is a low volume dripperline with integral and evenly spaced pressure compensating drippers at specified intervals in a discharge rate of 0.92 gallons per hour (GPH). Techline tubing is available in lengths of 100’, 300’ and/or 1000’

Techline: the dripperline shall consist of nominal sized one-half inch low density linear polyethylene tubing, housing internal pressure compensating, continuous self-cleaning, integral drippers at a specified spacing (12” centers). The tubing
shall be brown in color and conform to an outside diameter (O.D.) of 0.67 inches and an inside diameter (I.D.) of 0.57 inches. Individual pressure compensating drippers shall be welded as an integral part of the tubing assembly. These drippers shall be constructed of plastic with a hard plastic diaphragm retainer and a soft rubber diaphragm extending the full length of the dripper.

The drippers shall have the ability to independently regulate discharge rates, with an inlet pressure of (7-70 PSI) seven to seventy pounds per square inch (PSI), at a constant flow and with a manufacturer’s coefficient of variation (Cv) of 0.03. Recommended operating pressure shall be between 15-45 PSI. The dripper discharge rate shall be 0.92 gallons (GPH) utilizing a combination turbulent flow/reduced pressure compensation cell mechanism and a diaphragm to maintain uniform discharge rates. The drippers shall continuously clean themselves while in operation. The dripperline shall be 12” spacing between drippers unless otherwise specified. Techline pipe depth shall be 4” below grade.

For all installations, 6” metal wire staples shall be installed on 2’ on center. The Techline tubing shall be Netafim.

F. DRIPPERLINE ACCESSORIES

1. FITTINGS

Techline fittings shall be constructed in one of the following end configurations:
   • barbed insert fittings only,
   • male pipe threads (MPT) with barbed insert fittings, or
   • female pipe threads (FPT) with barbed insert fittings.

All fittings shall be constructed of molded brown plastic having a nominal outside dimension (I.D.) of 17 mm or (0.57”). Female and male threaded ends shall be capable of mating to standard PVC pipe threads with tapered threads.

Techline connections shall be mated with Netafim Techline tubing by pushing the tubing and twisting side to side until the tubing abuts to either adjoining tubing or a fitting stop. The Techline fittings shall be Netafim model numbers TLTEE, TLCOUP, TL2WO75MA, TLELL, TLCROS, TL075MA, & TL075FTEE.

2. LINE FLUSHING VALVE

Line Flushing Valves are used to reduce sediment build-up within the Techline tubing and to pass sediment or debris which may not have been captured by the disc filter.

The line flushing valve shall be constructed of brown molded plastic with one of the following end configurations:
   • 1/2” MPT
   • Insert barbed fitting
The line flushing valve shall operate at the beginning of the irrigation cycle as the system begins to pressurize, but before drip operation begins, and shall be capable of flushing approximately one gallon of water at 50 psi maximum, or 1.5 psi minimum. Note: Permanent damage could be sustained to the line flushing valve where incoming pressure exceeds 50 psi. Pressure regulators are required even with pressure regulating remote control valves which tend to pause for a brief period of time before pressure regulation occurs.

Line Flushing Valves are to be installed below grade, as detailed in a valve box to allow for periodic inspection and are to be installed in one of two ways:
- vertically: with the dome portion facing upward, installed on a 90 degree elbow.
- horizontally: with the dome portion facing sideways. The Line Flushing Valve shall be Netafim Model Number TL F-1.

3. AIR/VACUUM RELIEF VALVE

The air/vacuum relief valve serves two purposes; 1) to evacuate air from the Techline laterals during system start-up and, 2) to prevent a vacuum from occurring after the remote control valve has closed thus avoiding debris intrusion into the drippers at the higher locations in the zone.

The air/vacuum relief valve shall be constructed of black and/or grey plastic with a 1/2" male pipe thread capable of mating with a threaded PVC reduction bushing or 1/2” FIPT fitting.

Design and installation techniques require that these valves be installed at the highest elevation in each zone (some zones may require more than one) in order to expel air and relieve vacuum. In a zone where the highest elevation occurs between the intake and exhaust headers (such as a mound or berm), an air relief lateral shall interconnect the Techline Dripperlines to avoid the necessity of installing one air relief valve on each Techline lateral. Valves can be installed below grade in valve boxes to allow for periodic inspection. The air/vacuum relief valve shall be Netafim Model Number TLAVRV.

4. STAINLESS STEEL CLAMPS (for operating pressures in excess of 45 psi)

Stainless steel clamps are made to secure Techline tubing to insert barbed fittings. Clamps shall be manufactured by “Oetiker” and shall be one “ear” type. Nominal size recommended for use with Techline is 13/16”, Part No. 210.
Oetiker clamps shall be constructed of 304 AISI stainless steel. Clamps shall be one “ear” type and formed with a “dimple”, allowing for thermal expansion and contraction properties without loosening the clamp.

Interior clamp wall shall be smooth to prevent crimping or pinching of tubing. Wall thickness of clamps shall be .0236” (0.6 mm) with an overall band width of 1/4” (7 mm).

Stainless steel clamps are used to secure Netafim Techline tubing over barbed fittings when design operating pressures exceed 45 psi. Clamps are to be slipped over the tubing before being fitted to barbed insert fittings. Place the clamp between the first and second ridge of the barbed fittings. Crimp the “ear” of the clamp tightly with an Oetiker pincer tool. Crimp twice to ensure proper seating.

5. DRIPPER PLUG RING

The Netafim dripper plug ring is a plastic pre-formed ring with an inside rounded plug that can be used to plug Techline dripper outlets.

Slip the dripper plug ring over the Techline tubing and push the plug into the water outlet until it seats into the inlet hole securely. The Dripper Plug Ring shall be a Netafim Model Number TDLPLUG.

G. REDUCED PRESSURE BACKFLOW PREVENTION UNIT: Reduce pressure backflow prevention units shall be provided as indicated on drawings and shall be in compliance with local codes. - Model 860 Febco.

H. SOLVENT CEMENT: Compatible with PVC pipe and or proper consistence ADTM D-2564.

I. CONTROL WIRES: 24 volt solid wire, UL approved for direct burial ground. Minimum wire size 14 gauge. Common wire shall be 12 Gauge direct burial. All wire to be Paige wire or approved equal. All connections shall be made with water proof splice kits model 3M DBR.

J. WIRE EXPANSION CURLS: Expansion curls shall be provided within three (3) feet of each wire connection to solenoid and at least every three hundred (300) feet in length. (Expansion curls are formed by wrapping at least 5 turns of wire around a rod or pipe 1” or more in diameter, then withdrawing the rod).

K. SLEEVES FOR CONTROL WIRES: Under all walks and paving, Schedule 40 PVC pipe or galvanized heavy wall steel conduit. Minimum size 2” I.D.

1. Sleeves for Irrigation Pipe: Under all walks and paving, Schedule 40 PVC pipe or as otherwise approved by the Owner’s Representative. To be two (2) times the O.D. of sleeved pipe.

L. VALVE BOXES: Valve boxes shall be Dura Jumbo with locking lids or of appropriate size and type for valves specified. All valve boxes to have 6” pea gravel; with paver blocking and wrapped with filter fabric.
M. **DRAINS:** Air hose using Rain Bird quick coupler connections of approved design shall be provided for winterizing at several locations so that the entire system can be drained by blowing it out with compressed air. The compressor shall be capable of varying pressures.

N. **RUBBER HOSE:** A quantity of two (2) heavy duty rubber hoses, 50 feet long, for use with Rain Bird 1” hose swivel quick coupling valves shall be furnished by the Contractor.

O. **AUTOMATIC CONTROLLER:** Shall Be The Rain Bird™ ESP-LXMEF irrigation controller.

  - ESP-LXMEF irrigation controller specifications include but are not limited to:
    - The controller shall be of a hybrid type that is microelectronic circuitry capable of fully automatic or manual operation.
    - The controller shall be housed in a wall-mountable, weather resistant plastic cabinet with a key-locking cabinet door suitable for outdoor installation.
    - The controller shall have the ability to be programmed and operated in any one of six languages:
      - English
      - Spanish
      - French
      - German
      - Italian
      - Portuguese
    - The display shall show programming options and operating instructions in the chosen language without altering the programming or operation information.
    - The controller shall have user configurable formats for date, time, and units.
    - The controller shall have a base station capacity of 8 or 12 stations as well as three expansion slots capable of receiving station modules.
    - Each module shall be capable of receiving expansion modules of 4, 8, or 12 stations to create a controller capacity of up to 48 stations.
    - Modules shall be hot swappable and can be installed while in operation with the dial in any position and in any open module.
    - All stations shall have the capability of independently obeying or ignoring the weather sensor as well as using or not using the master valve.
    - The controller shall have a weather sensor override switch.
    - The weather sensors shall include but are not limited to:
      - Rain Bird™ Remote WR2 Rain/Freeze sensor to respond to rainfall and cold temperatures
      - The ESP-LXMEF shall be compatible with a Rain Bird™ ET Manager Cartridge (ETM-LXM) that enables weather-based management for the irrigation controller.
    - Station timing shall be from 0 minutes to 12 hours.
• The controller shall have a seasonal adjustment feature adjustable from 0% to 300% in increments of 1%.
• Seasonal adjustments shall be adjusted by each individual program.
• The controller shall also have a monthly seasonal adjustment feature adjustable from 0% to 300% by month in increments of 1%.
• Station timing with seasonal adjustment shall be from 1 second to 16 hours.
• The controller shall have 4 separate and independent programs which can have different start time, start day cycles and station run times.
• Each program shall have up to 8 start times per day for a total of 32 possible start times per day.
• The programs shall be allowed to overlap operations based on user-defined settings which control the number of simultaneous stations per program and total for the controller.
• The controller shall come standard with SimulStations™ which allows the user to define up to five 24 VAC, 7VA solenoid valves to operate simultaneously per program and total for the controller, including the master valve/pump start circuit.
• The controller shall have the capability of having a normally open or closed master valve programmable by station.
• The controller shall have a programmable station delay by program to allow for water well recovery or slow closing valves.
• The controller shall have an electronic, diagnostic circuit breaker “Even” day watering schedule without changing the date on leap years.
• The calendar shall include a permanent day off feature that allows a day(s) of the week to be turned OFF on any cycle (Custom/Odd/Odd31, and Cyclical).
• A day set to “Permanent Off” shall override the normal repeating schedule and not water on the specified day(s) of the week.
• The controller shall also have a calendar day off feature allowing the user to select up to 5 dates up to 365 days in the future when the controller shall not start programs.
• The controller shall incorporate a rain delay feature allowing the user to set the number of days the controller should remain off before automatically returning to the automatic operation mode.
• The controller shall have a Cycle+Soak™ water management feature which is capable of operating each station for a maximum cycle time and a minimum soak time to reduce water run-off.
• The maximum cycle time shall not be extended by seasonal adjustments.
• The controllers default operation shall be by station number.
• The controller shall provide an option to assign station priorities to determine the order in which stations shall operate.
• The controller shall ignore the station number sequence and instead operate the highest priority stations first and the lower priority stations last. Station priorities will be utilized by the FloManager™ feature if the FloManager™ feature is enabled.
• The controller shall offer a water window for each program
• The water window function sets the allowed start and stop time where watering is allowed.that shall sense a station with an electrical overload
or short circuit and shall bypass that station and continue operating all other stations.

- The controller shall have a 365-day calendar with leap year intelligence. The leap year intelligence allows the use of “Odd” or
- If watering cannot be completed by the time the water window closes, the stations with the remaining time are paused and watering automatically resumes when the next water window opens.
- The controller shall incorporate a FloManager™ feature that shall provide real-time flow, power, and station management.
- The controller shall offer a Flow Smart Module™ option which adds flow sensing functionality.
- The controller shall offer a Flow Smart Module™ input shall accept a direct pulse input from a flow sensor with no flow scaling device required.
- The controller shall have an alarm indicator light with an external case lens on the front panel visible through the outer door with the door closed and locked.
- The alarm light shall prompt the user to select the alarm softkey to review the alarm condition(s).
- The controller shall be compatible with the IQ v2.0 Central Control System utilizing IQ-NCC Network Communication Cartridges.
- The IQ-NCC Cartridge shall provide communication with the IQ Central Computer and other controllers via a variety of communication options (Direct Connect Cable, Phone, GPRS/Cellular, Ethernet, WiFi, Radio, and IQNet Communication Cable).
- The IQ v2.0 Central Control System shall provide remote computer control of the controller providing automatic or manual program adjustments.
- The controller shall offer an optional Rain Bird™ LXMM metal wall-mounted lockable cabinet and/or optional Rain Bird™ LXMMPED pedestal.
- The controller shall be capable of receiving Rain Bird™ ETC LX ET manager cartridge that shall upgraded the controller to a Smart controller
- The controller shall have multiple size wiring knockouts located on the bottom and the back side of the case to adapt to a wide variety of wiring applications, to facilitate installation and provide a clean professional look.
- The controller door and front panel shall be removable to allow the case to be mounted to a wall.
- The controller shall have a removable, programmable front panel for conveniently programming the controller away from the installation site or for teaching irrigation scheduling.
- The removable programmable front panel shall use a 9 volt battery.
- Shall include non-volatile (100-year) program memory to maintain the irrigation schedule indefinitely during a power outage.
- The controller shall operate on 120 VAC± 10% at 60Hz (230VAC ± 10% at 50Hz for international models; Australian models: 240VAC ± 10% at 50Hz).
- Shall include a standard 10kV surge protection.
- Shall include a diagnostic self-setting circuit breaker that identifies a valve or wire fault and continues to water operable stations.
• Shall include a RASTER™ station wiring test to allow the installer to test the valve wires during installation to determine the valve that each wire is connected to.
• The controller shall have Contractor Default™ default settings that allow the contractor to set his/her own default program.
• The program can be automatically recalled up to 90 days in the future.
• Shall be used for ease in restoring a schedule that has been altered or to replace a temporary schedule for new vegetation.
• The controller shall have the capacity for the program to be erased allowing the user to start programming with a blank controller.
• The controller shall have a reset button to reset the controller in the case of micro-controller “lock-up” due to power surges or frequent interruption to the power supply.
• The controller shall include a lithium coin-cell battery that shall maintain time and date during a power outage.
• Shall have the dimensions of:
  • Width: 14.32 in. (36.4 cm)
  • Height: 12.69 in. (32.2 cm)
  • Depth: 5.50 in. (14.0 cm)

• Rain Bird™ LXMM metal wall-mount case specifications include but are not limited to:
  • Field wiring connections shall occur in the controller.
  • The LXMM metal case shall be sized such that the standard plastic case of a Rain Bird™ ESP-LXME/ESP-LXMEF controller shall fit properly and securely in the case without altering the controller.
  • The controller shall be field installed into the metal case and can be mounted wall-mounted or attached to a Rain Bird™ LXMMPED.
  • The metal wall-mountable case shall include all necessary mounting bolt, nuts, and washers.
  • The metal wall-mount case shall be lockable.
  • The metal case shall be powder-coated steel.
  • The LXMM metal case shall have the dimensions of:
    • Width: 14.25 in. (36.2 cm)
    • Height: 12.875 in. (32.7 cm)
    • Depth: 7.75 in. (19.7 cm)

• Rain Bird™ LXMMPED metal pedestal specifications include but are not limited to:
  • Field wiring connections shall occur in the controller.
  • The LXMMPED metal pedestal shall be sized such that a Rain Bird™ LXMM shall fit properly and securely.
  • The metal pedestal case shall include all necessary mounting bolt, nuts, and washers.
  • The metal pedestal shall be powder-coated steel.
  • The LXMMPED metal pedestal shall have the dimensions of:
    • Width: 14.25 in. (36.2 cm)
    • Height: 28.00 in. (71.1 cm)
    • Depth: 7.25 in. (18.4 cm)
PART 3.00 - EXECUTION

3.01 STAKE-OUT

A. General: Examine areas and conditions under which irrigation system’s materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

B. Stake out entire system, including pipes and valves. Final stake-out shall be reviewed by the Owner’s Representative prior to trenching to ensure that no conflicts with related site improvements occur.

3.02 EXCAVATION AND BACKFILL

A. The Contractor shall furnish all labor, materials, and equipment for the excavation and backfilling of pipe trenches, and other structures as shown on the Drawings. This item of work includes trench excavation, disposal of excavated materials, sheeting and shoring, disposal of surface and ground water, protection of existing streets and structures pipe embedment, trench backfill, and the maintenance of the construction area during progress of the work. The described includes delivery and storing of material and all vehicular traffic related thereto.

B. The width of trenches for installation of irrigation lines shall be in accordance with pipe manufacturer's requirements, all applicable codes of the City, County and State in which installation is accomplished and utility company regulations. Trench widths shall not be less than is necessary for proper construction.

C. The depth of the irrigation line trenches shall:
   1. 18” minimum cover over main lines;
   2. 12” minimum cover over lateral control lines from controller to valves;
   3. 4” minimum cover over lateral line drip tubing;

D. Irrigation line trenches shall be excavated in a manner that will provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point.

E. Backfilling of all trenches shall be with clean fill, free of rock and debris. If in rock excavated section, pipe shall be installed in a bed of sand six (6) inches to each side above and below pipe.

F. All trenches shall be backfilled and compacted every six (6) inches of fill.

3.03 PIPE AND ASSEMBLY
A. Carefully inspect all pipe, fittings, and accessories before installation. Reject any defective material.

B. Remove all fins and burrs and thoroughly clean all pipe fittings and accessories before jointing and placement.

C. Cut pipe accurately to measurements established at the site and work into place without springing or forcing.

D. Plastic pipe and fittings shall be solvent welded using solvents and methods as recommended by the manufacturer of the pipe, except where screwed connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before applying solvent with a non-synthetic bristle brush.

E. Grade pipe in straight lines with no dips or low points. The full length of each section of pipe and fitting shall rest solidly on the pipe bed with recesses excavated to accommodate joints and couplings. Provide anchors and supports where necessary for fastening work into place.

F. No pipe shall be laid when, in the opinion of the Project Consultant, trench or weather conditions are unsuitable. When pipe laying is not in progress, the open ends of the installed pipe shall be closed by approved means to prevent entrance of trench water and other foreign material into the line. Enough backfill shall be placed in the center sections of the pipe to prevent floating. Any pipe that has floated shall be removed from the trench and re-laid.

G. All pipe crossing sidewalk areas shall have a minimum of 18" cover over pipe and be installed in a 4" schedule 40 PVC pipe sleeve. All sleeving shall extend 18" beyond the edge of pavement, curb or building face. Assembly of piping shall meet all manufacturer's requirements.

H. Pipe shall be protected during storage and handling against impact shocks, or free fall. Pipe shall be kept clean at all times and no pipe shall be used that does not conform fully with standards or specifications herein described. All pipe and appurtenances shall be installed in strict accordance with these specifications. Any section of pipe found to be defective either before or after laying shall be replaced with new sections without additional expense to the owner.

I. Pipe may be assembled and welded on the surface. Snake pipe from side to side in the trench to allow for expansion and contraction.

J. Before lowering into the trench, each section of pipe shall be inspected for defects. Defective pipe shall be rejected. Deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed piping manufacturer's requirements for snaking. If alignment required deflections in excess of limitations or undue stress upon the pipe, the Contractor shall provide joints or a sufficient number of shorter lengths of pipe to provide angular deflections within the limit set forth.
K. During construction operations, the pipe interior shall be kept clean by means of plugs or other approved methods. Pipe shall not be laid in water, or when trench or weather conditions are unsuitable for work proposed, except by permission of the Architect. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other materials will enter the pipe of fittings. Prior to completing the joint, the Contractor shall insure that each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate the joints. Pipe shall be laid at locations shown on the drawings.

L. All pipe and appurtenances shall be installed so as to prevent contact with rock, mulch, or other excessively acid, alkaline, or unstable soils, destructive to physical properties of the pipe. Under these conditions pipe will be set in a bed of sand.

M. Make all connections between plastic pipe and metal valves or steel pipe with threaded fittings using plastic male adapters. All Sprinkler heads shall be connected with pre-manufactured swing joint assemblies. As manufactured by Dura or approved equal.

N. Valves:
1. All valves shall be installed in accordance with details and this specification. Where possible, control valves shall be manifol ded in parallel and installed in one valve box.
2. Install remote valves where shown and group together where practical; place no valve closer than six (6) inches to walk edges, buildings and walls. Locate all valve boxes in planting beds unless otherwise directed or noted.

3.04 DRIPPERLINE INSTALLATION

A. Techline is designed for use in sub-surface applications utilizing a grid design, the result being a complete wetted area within the grid. The most uniform way to install Techline is sub-surface at a uniform depth in a grid design as specified.

B. Techline dripper flow rates shall be 0.92 gallons per hour (gph) with drippers spaced at 12 inch intervals. The drippers are designed to regulate flow at the specified output from 7 psi to 70 psi with maximum recommended pressure of 45 psi when using unclamped Techline insert fittings.

C. The choice of dripper spacing, Techline lateral spacing and depth was selected based on the soil type and plants being used.
D. It is necessary to use Techline insert fittings for all Techline connections to ensure the integrity of the connection. Techline dripperline has an ID of 0.57”, or 17 mm, which differs from most other polyethylene tubing dimensions and improperly sized fittings will cause leaks.

   1. Techline shall be installed by:
      a. Trenching,
      b. Laying it out on a sub-grade lower than finished grade and backfilling to the specified grade depth,
      c. Vibratory plow,
      d. The installation shall use Techline staples (TLS6) spaced 24” apart to hold it in place along with a four (4) to six (6) inch soil cover.

E. Drip Tubing: Install all drip tubing as detailed on drawings or specifications. Use only Teflon tape on all threaded connections.

F. Closing of Pipe and Flushing Lines:
   1. Cap or plug all openings as soon as lines have been installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
   2. Thoroughly flush out all water lines before installing valves and other hydrants.
   3. Test in accordance with Paragraph on Hydrostatic Tests.

G. Backfilling and Compacting:
   1. After system is operating, and required tests and inspections have been made, backfill excavations and trenches with clean soil, free of rubbish.
   2. Backfill for all trenches, regardless of type of pipe covered, shall be compacted to minimum 90% density.
   3. Compact trenches in areas to be planted by thoroughly flooding the backfill.
   4. Dress off all areas to finish grades.

3.05 VALVE BOXES

A. All valve boxes shall be installed in accordance with details and this specification.

B. Valve boxes shall be set on firm paver base, wrapped in landscape filter fabric, and allow for drainage with 6” of clean washed pea gravel. See Details.

3.06 CONTROLLER

A. Controller shall be installed on the proposed shelter building as indicated on the drawings.
B. Connect remote control valves to controller in a logical sequence to correspond with specification of the Owner or Project

3.07 CONTROL CABLE

A. Install control wires at least six (12) inches below finish grade and lay to the side and below main line. All control cable shall be of 12 and 14 gauge size for voltage drops and shall be installed in PVC conduit where applicable. Pipe trench shall be partially backfilled to provide three to four inches of cover over the pipe before wire is installed. Wire shall then be placed in the trench to one side of the pipe. Wire shall be "snaked" into the conduit as loose as possible and with as much "slack" as possible to allow for expansion and contraction of the wire. If it is so desired, rather than leaving slack in the wire, expansion joints in the wire may be provided at 200 foot intervals by making 5 to 6 turns of the wire around a piece of 1/2" pipe. Where it is necessary to run wire in a separate trench, the wire shall have a minimum cover of 18".

B. Control wire splices will be allowed only in runs more than five hundred (500) feet. Connections of all underground wires shall by the use of wire nuts, covered with 3M DBR waterproof splice for each wire per installation instructions provided by the manufacturer, or as otherwise required by local ordinance.

C. Install control wires, sprinkler mains and laterals in common trenches whenever possible.

D. All wires passing under existing or future paving, construction, etc., shall be encased in plastic or galvanized steel conduit extending at least twelve (12) inches beyond edges of paving or constructions.

E. All wire connections at remote control valves shall be made in control boxes and shall be left with sufficient slack so that in case of repair the valve bonnet of splice may be brought to the surface without disconnecting the wires.

F. Each individual controller shall have a separate common ground wire system entirely independent of the common ground wire system of all other controllers. Only those remote control valves which are being controlled by one controller, shall be connected to that controller's common ground wire system.

3.08 DRIP LINES

A. All drip lines, Headers, footers and drip connections shall be installed in accordance and as the intent of the details on the drawings.

3.09 FLUSHING AND TESTING

A. Hydrostatic Test:
   1. Request the presence of the Owner and /or Landscape Architect at least 48 hours in advance of testing.
   2. Testing to be accomplished at the expense of the Contractor, and in the presence of the Owner.
3. Center load piping with small amount of backfill to prevent arching or slipping under pressure.

4. Apply a continuous and static water pressure of no more than 60 psi when welded plastic joints have cured at least 24 hours and with the risers capped as follows:
   a. Main Lines and sub mains to be tested for one (1) hour.
   b. Lateral lines to be tested for one (1) hour.

5. Repair leaks resulting from tests.

6. The lines shall then be retested until deemed satisfactory.

3.10 INSTRUCTIONS

A. After completion and testing of the system, the Contractor will instruct the Owner’s personnel in the proper operation and maintenance of the system. He shall set up the controller with a base irrigation schedule. He shall issue the owner a binder with owners manuals, product cut sheets, parts sheets, and an as built of the system.

3.11 PROTECTION

A. Contractor shall be responsible for work until finally inspected, tested and accepted. After delivery, and before and after installation, protect work against theft, injury or damage. Protect open ends of work with temporary covers or plugs during construction, to prevent entry of obstruction material.

3.12 WINTERIZATION AND START-UP

A. The Contractor shall winterize the system using compressed air for two (2) hours at no more than 30 psi

B. The Contractor shall be responsible for the two year period as noted in Section 1.12. This includes first start-up the following season and winterization.

C. Irrigation Contractor shall be responsible for providing flush / valves at the ends of the drip line for flushing the system. An access box flush with finish grade as shown on the drawings shall be furnished as necessary.
   1. Contractor shall be responsible for reviewing the system's features, operations and procedures with appropriate Owner's representatives to train them on all annual winterizing and start-up maintenance functions.

END OF SECTION 328400
SECTION 329100  LANDSCAPE AGGREGATE MATERIALS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work in this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the installation of Landscape Aggregate Materials as shown on the drawings and/or specified herein, including but not necessarily limited to the following:

1. Delaware River Stone

1.3 RELATED SECTIONS

SECTION 312000   Earthwork
SECTION 329300   Trees, Shrubs and Groundcover

1.4 SUBMITTALS

A. Submit gradation and material analysis for all types of aggregate materials to Owner's Representative, for approval prior to ordering or delivering to site.

B. Materials Source: Submit name of imported materials suppliers to Owner's Representative.

C. Representative samples of river stone.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with applicable state and local standards.

1. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials as directed by the Engineer.

PART 2 - PRODUCTS
2.1 RIVER STONE:

A. Shall be a Delaware Blend or other approved hard and durable rounded stone of which 80% shall be 3”-5”, and 20% shall be 5”-8” dia., smooth, with a color range of tan to gray to red as distributed by Geo. Schofield Co., Harford, Pennsylvania, 570-434-2536) or approved equal.

B. Fabric under stone by Tencate Mirafi Drainage & Separation Geosynthetics.

2.2 SOURCE QUALITY CONTROL

A. Provide materials of each type from same source throughout the work.

PART 3 - EXECUTION

3.1 STOCKPILING

A. Stockpile materials on site as needed at locations designated by the Owner’s Representative.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

3.2 PLACEMENT OF AGGREGATE MATERIALS

A. Take field measurements prior to placement of materials to confirm that setting elevations are correct.

B. Coordinate with work of other sections; provide coordination documents as needed. Install materials in a neat and workman like manner.

C. Fine aggregate materials shall be spread smooth and evenly to achieve the desired depth. Care shall be exercised to protect adjacent work.

D. River stone shall be placed and adjusted as directed by the Landscape Architect to achieve the desired location and facing of the stone. Contractor shall protect stone from scrapes or markings that would detract from the natural appearance of the stone.

3.3 STOCKPILE CLEANUP

A. Remove stockpile; leave area in a clean and neat condition. Grade site surface to prevent freestanding surface water.

END OF SECTION
SECTION 329200 LAWNS & GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Seeding.
   2. Sodding

B. Related Sections include the following:
   1. Section 312000 Earthwork.
   2. Section 329300 Trees, Shrubs, & Groundcover

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Planting Mix: Native or imported topsoil; mixed with soil amendments and compost as specified.

C. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

D. Compost: Well decomposed, mature, stable, weed-free and produced by aerobic decomposition of organic matter.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. 1 lbs. of Topsoil for each soil type tested, in labeled plastic bags

C. 1 lbs. of Compost in labeled plastic bag

D. Certification of Grass Seed: From seed vendor stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

E. Product Certificates: For soil amendments and fertilizers, signed by product manufacturer.
F. Qualification Data: For landscape Installer.

G. Material Test Reports: For existing surface soil, and imported topsoil.
   1. Existing Source Soil: 1 material test report for each topsoil type.
   2. Imported Topsoil: 1 material test report for each 250 cubic yards (200 cubic meters) of material from random samples.

H. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawn during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment, and with a minimum of five years of related experience.
   1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed. Qualified independent soil-testing laboratories include but are not limited to:
   1. Keen Consulting Inc., Georgetown, Delaware; telephone: 302-684-5270; in collaboration with Brookside Laboratories, Inc.; or approved equal.

C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter (oven-dried weight), gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH and buffer pH; and mineral and plant-nutrient content of topsoil, including phosphorus, potassium, magnesium, manganese, iron, zinc, and calcium.
   1. Provide particle size analysis according to the following gradient of mineral content:

<table>
<thead>
<tr>
<th>USDA Designation</th>
<th>Size in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>+2 mm</td>
</tr>
<tr>
<td>Very coarse sand</td>
<td>1 - 2 mm</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>0.5 – 1 mm</td>
</tr>
<tr>
<td>Medium sand</td>
<td>0.25 – 0.5 mm</td>
</tr>
<tr>
<td>Fine sand</td>
<td>0.1 – 0.25 mm</td>
</tr>
<tr>
<td>Very fine sand</td>
<td>0.05 – 0.1 mm</td>
</tr>
<tr>
<td>Silt</td>
<td>0.002 – 0.05 mm</td>
</tr>
<tr>
<td>Clay</td>
<td>Smaller than 0.002 mm</td>
</tr>
</tbody>
</table>

   2. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be
added to produce satisfactory topsoil and to comply with the following ideal percentages of base saturation and pH:

<table>
<thead>
<tr>
<th>Element</th>
<th>Desired Percentage Range</th>
<th>Ideal Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>60 – 70</td>
<td>68</td>
</tr>
<tr>
<td>Mg</td>
<td>10 – 20</td>
<td>12</td>
</tr>
<tr>
<td>K</td>
<td>2 – 5</td>
<td>5</td>
</tr>
<tr>
<td>Na</td>
<td>0.5 – 3.0</td>
<td>0.75</td>
</tr>
<tr>
<td>Other Bases (variable)</td>
<td>2 – 4</td>
<td>3.75</td>
</tr>
<tr>
<td>Exchangeable Hydrogen</td>
<td>10 – 15</td>
<td>10.50</td>
</tr>
<tr>
<td>pH</td>
<td>6.3 – 6.9</td>
<td>6.75</td>
</tr>
</tbody>
</table>

1.6 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

B. SCHEDULING: SEEDING BETWEEN AUGUST 20 – SEPTEMBER 20 or as otherwise approved by owner and Landscape Architect.

C. Planting Restrictions: Plant when soil temperature is 50 degrees minimum and no higher than 85 degrees maximum.

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

E. If planting season is missed, seed areas with cover crop to stabilize. Seed with specified mixes in the next planting season. Review with Landscape Architect for soil preparation instructions.

F. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.7 WARRANTY

A. Special Warranty: Warrant following lawns and grasses for warranty periods indicated against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor’s control.

1. Warranty Period for Seeded Lawns: 90 days from date of Substantial Completion.

2. When full Warranty Period has not elapsed before end of planting season, or if lawns are not fully established, continue Warranty Period to next planting season.

1.8 LAWN MAINTENANCE
A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Seeded Lawns: 90 days from date of Substantial Completion.
   a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

B. Maintain and establish lawn by watering, fertilizing, weeding, mowing- if required, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   2. Water lawn, supplementing rainfall, to provide a total minimum rate of 1 inch per week and watering every other day for 20 minutes during the first sixty days.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to:
   1. Lawn Seed Mix:
      a. Manufacturer: L.D. Oliver Seed Co., Inc., telephone: 800-624-2952 or approved equal.

2.2 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Turf Lawn: Substitutions not permitted unless approved by Landscape Architect. Proportioned by weight as follows:
   a. 45 percent Pennlawn Red Fescue (Festuca rubra variety).
   b. 25 percent Victory II Chewing Fescue (Festuca rubra variety commutata).
   c. 10 percent Fiesta III Perennial Ryegrass (Lolium perenne).
d. 10 percent SR 5200 Red Fescue (*Festuca rubra* variety).

e. 10 percent Tall Fescue (*Festuca arundinacea*)

### 2.3 TURFGRASS SOD

A. Turfgrass Sod: **Approved Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects**, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Sod of grass species as follows:

- a. 90 percent Tall Fescue (*Festuca arundinacea*)
- b. 10 percent Kentucky Bluegrass (*Poa pratensis*)

### 2.4 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 6.5, a minimum of 2 percent organic material content; free of subsoil, refuse, roots, heavy or stiff clay, stones 1 inch or larger in any dimension, noxious seeds, sticks, brush, litter, and other extraneous materials harmful to plant growth.

- a. Supplement with imported topsoil from off-site sources when quantities are insufficient to obtain a minimum of 4” depth of topsoil mix. Obtain topsoil displaced from naturally, well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

### 2.5 INORGANIC SOIL AMENDMENTS

A. Sand (if required by Topsoil Analysis): ASTM C33, clean, washed, natural or manufactured, free of limestone, shale, and slate particles, free of toxic materials and with following particle size distribution:

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percentage Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 in (9.5 mm)</td>
<td>100</td>
</tr>
<tr>
<td>No. 4 (4.75 mm)</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 8 (2.36 mm)</td>
<td>80 – 100</td>
</tr>
<tr>
<td>No. 16 (1.18 mm)</td>
<td>50 - 85</td>
</tr>
<tr>
<td>No. 30 (0.60 mm)</td>
<td>25 - 60</td>
</tr>
<tr>
<td>No. 50 (0.30 mm)</td>
<td>10 – 30</td>
</tr>
<tr>
<td>No. 100 (0.15 mm)</td>
<td>2 - 10</td>
</tr>
</tbody>
</table>

### 2.6 ORGANIC SOIL AMENDMENTS

A. Compost (REQUIRED): 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 1/2-inch sieve;
soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

B. Compost may be derived from: agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; source-separated or mixed solid waste. The product shall contain no substances toxic to plants and shall be reasonably free (< 1% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived. **Do not use compost that has received the addition of liming agents or ash by-products.** The product shall be certified through the U.S. Composting Council’s (USCC) Seal of Testing Assurance (STA) Program.

2.7 MULCHES

A. Hydraulic Fiber Mulch

B. Nonasphaltic Tackifier: Colloidal tackifier recommended for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.8 PLANTING MIX

A. Testing of Soil After Lawn Preparation

1. Have one (1) composite sample of Topsoil Mix with Compost incorporated tested from each 500 c.y. of material to include the following.

2. Nutrient Analysis:
   a) Have nutrient levels (nitrate nitrogen, phosphate, potassium, magnesium, calcium, ammonium, iron, and manganese) tested. The analysis tests shall show recommendations for soil additives or fertilizers to correct soil mixes’ deficiencies as necessary.
   b) Nutrient deficiencies shall be corrected at time of installation.

3. Soluble salts measurement is less or equal to 2 mmho/cm.

4. Percolation test to ensure adequate drainage and proper mixing of Compost.

5. Toxic Substance content.

6. Per results of Soil Testing, bring Planting Mix to pH levels between 6.5 and 6.8 for lawn and verify by follow-up testing. **Lower pH by using elemental sulfur product. Peat moss or copper sulfate may not be used to lower pH.**

PART 3 - EXECUTION
3.1 EXAMINATION

A. Examine areas to receive lawn for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. CONTRACTOR TO SUBMIT A METHOD OF PLANTING/SEEDING TO THE LANDSCAPE ARCHITECT FOR APPROVAL PRIOR TO STARTING WORK.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect adjacent and adjoining areas from hydroseeding overspray.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN PREPARATION

A. Soil Preparation:
   1. Spread topsoil to depths indicated but not less than required to meet finish grades after addition of amendments, light rolling and natural settlement. Do not spread if topsoil or subgrade is frozen, muddy, or excessively wet. Apply soil amendments on surface and mix thoroughly into topsoil.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.

C. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.4 LAWN SEEDING –

A. Hydroseeding: Mix specified seed, fertilizer and hydraulic fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
   1. Do not use wet seed or seed that is moldy or otherwise damaged.
   2. Retain applicable tackifier below for improved erosion control.
   3. Mix slurry with nonasphaltic tackifier.
   4. Apply slurry uniformly to all areas to be seeded in a one-step process.
B. Sow seed at the following rates:

1. Lawn Seed Mix: 50 lb/1000 sf.

3.5 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.6 SATISFACTORY LAWNS

A. Satisfactory Seeded Lawns: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 3 by 3 inches.

B. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

C. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.7 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

END OF SECTION
SECTION 329300  TREES, SHRUBS, GROUNDCOVERS & PLANTING SOIL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes, but may not be limited to, the following:
   1. Trees
   2. Shrubs
   3. Ground covers and perennials
   4. Topsoil and soil amendments for planting bed areas
   5. Structural Soil for Tree pit Areas.
   6. Fertilizers for planting bed areas.
   7. Mulches for planting bed areas and trees

1.03 SUBMITTALS

A. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
   1. Antidesiccant
   2. Mycorrhiza
   3. Root Dip Gel
   4. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
   5. Label data substantiating plants comply with specified requirements.

B. List of nurseries where plants will be obtained, including contact information, and list of plants by type and nursery location.

C. Samples: For the following:
   1. Triple Shredded Bark Mulch, one (1) lbs in labeled plastic bag.
   2. Compost, two (2) lbs in labeled plastic bag. Include source, guaranteed analysis, and weight for packaged material.
   3. Ground Limestone: two (2) lbs in labeled plastic bag. Include guaranteed analysis, and weight for packaged material (if Required).
   4. Fertilizer: Include guaranteed analysis.
   5. Leaf Litter: two (2) lbs in labeled plastic bag (if Required).

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and address of landscape architects and owners, and other information specified.
E. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with requirements indicated:
   1. Analysis of topsoil.

F. Planting & Installation Schedule: Submit proposed planting & installation schedule, indicating dates for completion of work items, as coordinated with Construction Manager, plant tagging, soil testing, digging of woody plants, and installation of each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

G. Submit letter notifying the Owner and Landscape Architect of completion of planting work and requesting inspection to determine acceptability for Substantial Completion and beginning of Warranty Period.

H. If Owner chooses to perform all or part of the maintenance during the Warranty Period, submit maintenance instructions to be performed by the Owner and set up a schedule for regular on-site review to assure compliance. Submit instructions and schedule before date of Substantial Completion.

I. Submit letter to the Owner and Landscape Architect requesting a final inspection of planting work for Final Acceptance at end of Warranty Period.

J. STRUCTURAL SOIL
   1. Certificate and test results for CU-Structural Soil® including the following:
      a. Submit a mechanical analysis of the clay loam sample and particle size analysis including the following gradient of mineral content:

         | USDA Designation | Size in mm. |
         |------------------|-------------|
         | Gravel +2 mm     |             |
         | Sand 0.05 – 2 mm |             |
         | Silt 0.002-0.05 mm |         |
         | Clay minus 0.002 mm |          |

      1) Sieve analysis shall be performed and compared to USDA Soil Classification System.
      2) Sieve analysis shall be done by a combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D422 after destruction of organic matter by hydrogen peroxide.
      3) Submit soil test analysis reports for sample of clay loam from an independent soil-testing laboratory. The testing laboratory for particle size and chemical analysis may include a public agricultural extension service agency.

      b. Submit a chemical analysis, performed in accordance with current AOAC Standards, including the following:
1) pH and buffer pH.

2) Percent organic matter as determined by the loss of ignition of oven dried samples. Test samples shall be oven dried to a constant weight at a temperature of 230°F, plus or minus 9°F.

3) Analysis for nutrient levels by parts per million.

4) Soluble salt by electrical conductivity of a 1:2 soil/water sample measured in Millimho per cm.

5) Cation Exchange Capacity (CEC).

6) Carbon/Nitrogen Ratio.

c. Particle size analysis for crushed stone which will be used in production of CU-Structural Soil®:

<table>
<thead>
<tr>
<th>USDA Designation</th>
<th>Size in mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3”</td>
<td>+76 mm</td>
</tr>
<tr>
<td>2 1/2”</td>
<td>63-76 mm</td>
</tr>
<tr>
<td>2”</td>
<td>50-63 mm</td>
</tr>
<tr>
<td>1 1/2”</td>
<td>37-50 mm</td>
</tr>
<tr>
<td>1”</td>
<td>25-37 mm</td>
</tr>
<tr>
<td>3/4”</td>
<td>19-25 mm</td>
</tr>
<tr>
<td>Fine gravel</td>
<td>2-19 mm</td>
</tr>
</tbody>
</table>

1) Provide the manufacturers analysis of the loose and rodded unit weight

2) Losses from LA Abrasion tests- not to exceed 40%

3) Minimum 90% with 2 or more fractured faces

4) Percent pore space analysis

2. Samples

1. CU-Structural Soil®
Submit from licensed producer, 1/2 cubic foot representative sample of clay loam, one cubic foot representative sample of crushed stone, and one cubic foot representative sample of CU-Structural Soil® mix for approval. In the event of multiple source fields for clay loam, submit a minimum of one set of samples per source field or stockpile. The samples of all clay loam, crushed stone, and CU-Structural Soil® shall be submitted to the engineer as a record of the soil color and texture.

1.04 QUALITY ASSURANCE
A. Installer Qualifications: Engage an experienced Installer who has completed planting work similar in material, design, and extent to that indicated for this Project and with a record of successful plant establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that planting is in progress.

B. Topsoil Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Landscape Architect’s satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E-699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the work.

1. Qualified independent soil-testing services include, but are not limited to:
   a. Ingram Engineering Services, Inc.
      16 Hagerty Boulevard, Suite 400
      West Chester, PA 19382
      Phone: (484) 947-5549
      Email: info@ingram-engineering.com
   
   b. Penn State Agricultural Analytical Services Laboratory
      111 Ag Analytical Services Lab
      University Park, PA 16802
      Phone: (484) 947-5549
      Email: aaslab@psu.edu

C. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements of ANSI-Z60.1 "American Standard for Nursery Stock." Identify nursery source or collection site for all plant materials and schedule for tagging to Landscape Architect for approval.

1. Selection of trees and shrubs will be made by Landscape Architect, who may tag stock at their place of growth before they are prepared for transplanting.

D. Tree and Shrub Measurements: Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches tip-to-tip.

E. Observation: Landscape Architect may observe trees and shrubs at site before planting for compliance with requirements for genus, species, variety, size and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.

F. Substitutions: Substitutions will only be considered after review of plant availability with Landscape Architect. Submit request for substitutions in writing to the Landscape Architect before selection of plants by Landscape Architect.
G. Pre-installation Conference: Conduct conference at Project site.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.

B. Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sunscald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop plants during delivery.

C. Handle balled and burlapped stock by the root ball.

D. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set plants in shade, protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of plants stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

E. All plant material must have labels showing botanical name on each individual plant.

1.06 PROJECT CONDITIONS

A. Utilities: Determine location of above grade and underground utilities and perform work in a manner, which will avoid damage. Hand excavate, as required. Maintain grade stakes until parties concerned mutually agree upon removal.

B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect before planting.

1.07 COORDINATION AND SCHEDULING

A. Coordinate installation of plants during the following planting seasons for each type of plant required and during suitable soil and climatic conditions:

B. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns, unless otherwise acceptable to Landscape Architect.

1. When planting trees and shrubs after lawn, protect lawn areas and promptly repair damage caused by planting operations.
1.08 WARRANTY

A. Special Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

1. Warranty Period: Warrant the living plants for a period of two (2) years after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.

2. Remove dead plants immediately. Replace immediately unless required to plant in the succeeding planting season.

3. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

4. A limit of one replacement of each plant will be required, except for losses or replacements due to failure to comply with requirements.

5. At end of Warranty Period, cut bindings around base of trunks and remove loose materials. Distribute, add, and/or replace mulch as needed.

1.09 MAINTENANCE

A. Tree, Shrub & Groundcover Maintenance

1. Maintain trees, shrubs, groundcovers and perennials by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Maintain trees and shrubs for the following period:

2. Maintenance Period: TWO (2) years following Substantial Completion.

3. Fertilize trees approximately one year after installation between October and December, or between February and April. Unless otherwise indicated by soil test results, apply at rate of 2 pounds of actual nitrogen per 1,000 square feet. Make insertion points approximately 2-1/2 feet apart, at a depth of 6 inches. Applying fertilizer in the ball and backfill area, and to approximately 1 foot outside of the planting hole.

4. Watering: Provide temporary watering equipment to convey water from sources. Review watering needs and weather conditions with Owner and Landscape Architect. Water as directed by Owner.

5. At end of Warranty Period cut and remove remaining bindings, burlap and wire from tops of tree and shrub root balls. Distribute and replace mulch as needed to maintain mulch depth.

PART 2 - PRODUCTS

2.01 TREES AND SHRUBS

A. General: Unless otherwise indicated, furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide
well-shaped, fully-branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sunscald, injuries, abrasions, and disfigurement. Provide plants having as natural a shape as possible, characteristic of the species in the native condition. Plants shall be grown on their own roots.

B. Grade: Provide trees and shrubs of sizes and grades conforming to ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of root balls.

C. Acquire plants from nurseries in New Jersey/Pennsylvania/New York/Connecticut region and confirm availability with Landscape Architect.

2.02 TREES

A. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI 60.1, and stem form as follows:

1. Form: Single stem straight trunk, specimen quality. See planting schedule for special conditions and branch height.

2. Form: Multistem, clump, with 2 to 3 main stems as shown. Trees with more than four stems may be rejected upon inspection by Landscape Architect.

B. Provide balled and burlapped trees.

2.03 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs 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. See planting schedule for special conditions.

B. Provide balled and burlapped deciduous shrubs.

1. Container-grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to meeting ANSI Z60.1 limitations for container stock.

2.04 BROADLEAF EVERGREENS

A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.

B. Provide balled and burlapped or container-grown plants.

2.05 GROUNDCOVERS AND PERENNIALS

D. Provide ground covers and perennials established and well rooted in removable containers or integral pots and with not less than the minimum number and length of runners required by ANSI-Z60.1 for the pot size indicated.
E. Acquire plants from nurseries in New Jersey/Pennsylvania/Delaware region and confirm availability with Landscape Architect.

2.06 BALLED AND BURLAPPED STOCK

A. Provide trees and shrubs dug with firm, natural ball of earth in which they are grown.

B. Caliper Size: Not less than indicated in Plant Schedule.

C. Wrap, tie and rigidly support earth ball as recommended by ANSI Z60.1 for size of ball required. Ball supporting device shall be wire baskets and shall hold the ball in a firm rigid condition. Drum-lace balls with a diameter of 28 inches or greater.

D. Ball Wrapping Materials: Untreated, biodegradable burlap, twine and ropes or similar material. Wire baskets permitted.

E. Trunk Protection: Wax cardboard secured around trunk to 3-1/2-foot height.

2.07 CONTAINER-GROWN STOCK

A. Provide healthy, vigorous, well-rooted plants established in containers. Provide balled and burlapped stock when required trees or shrubs exceed maximum size recommended by ANSI Z60.1 for container-grown stock.

1. Established container stock is defined as plant transplanted into container and grown in container long enough to develop new fibrous roots, so that root mass will retain its shape and hold together when removed from container.

B. Containers: Rigid containers that will hold ball shape and protect root mass during shipping. Provide plants established in containers of not less than minimum sizes recommended by ANSI Z60.1 or as indicated on Plant Schedule for kind, type, and size of plant required.

2.08 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 6.5, a minimum of 2 percent organic material content; free of subsoil, refuse, roots, heavy or stiff clay, stones 1 inch or larger in any dimension, noxious seeds, sticks, brush, litter, and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on-site. Do not stockpile topsoil more than 6 feet high. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

2. Supplement with imported topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally, well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

2.09 SOIL AMENDMENTS
A. Lime: ASTM C-602, Class T, agricultural limestone, calcitic or dolomitic, as required by Topsoil Analysis.

B. Aluminum Sulfate: Commercial grade, unadulterated.


D. Water: Potable.

E. 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 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Compost may be derived from: agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; source-separated or mixed solid waste. The product shall contain no substances toxic to plants and shall be reasonably free (< 1% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived. Do not use compost that has received the addition of liming agents or ash by-products. The product shall be certified through the U.S. Composting Council’s (USCC) Seal of Testing Assurance (STA) Program.

2. Obtain certified compost.

2.10 FERTILIZER

A. As required by Topsoil Analysis for ericaceous plants. See Article on Planting Mix.

2.11 MULCHES

A. Hardwood Bark Mulch: Ground or triple shredded hardwood bark mulch, free from deleterious material. The basis of acceptance shall be manufacturer’s label or Certificate of analysis by an approved laboratory indicating compliance with material requirements.

B. Leaf Litter: chopped or shredded leaves, free of weeds, seeds, loam, sand, clay, and other foreign substances. Acquire leaf litter locally, or other approved source.

2.12 MISCELLANEOUS MATERIALS

A. Mycorrhiza: Mycorrhiza: Mycorrhizal innoculant product as manufactured by or approved equivalent:

B. Root Dip Gel: Root Dip Gel: Root dip, water holding gel –

2.13 PLANTING MIX

A. For Areas noted on Drawings to receive Perennial Planting, install Planting Mix.

B. Planting Mix consists of:
   1) Topsoil mixed with Compost and other soil amendments based on soil analysis and in quantities recommended in the topsoil analysis.

C. Acceptable ranges for base saturation percentages are:

   BASE SATURATION

<table>
<thead>
<tr>
<th>Element</th>
<th>Desired % Range</th>
<th>Ideal %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>60-70%</td>
<td>68%</td>
</tr>
<tr>
<td>Mg</td>
<td>10-20%</td>
<td>12%</td>
</tr>
<tr>
<td>K</td>
<td>2-5%</td>
<td>5%</td>
</tr>
<tr>
<td>Na</td>
<td>0.5-3%</td>
<td>0.75%</td>
</tr>
<tr>
<td>Other bases (variable)</td>
<td>2-4%</td>
<td>3.75%</td>
</tr>
<tr>
<td>Exchangeable Hydrogen</td>
<td>10-15%</td>
<td>10.50%</td>
</tr>
<tr>
<td>pH</td>
<td><strong>5.5-6.0</strong></td>
<td><strong>5.75</strong></td>
</tr>
</tbody>
</table>

D. Testing of Soil after Planting Bed Establishment

   1. Have one (1) composite sample of Planting Mix with Compost incorporated tested from each 50 c.y. of material to include the following.

   2. Nutrient Analysis:
      a) Have nutrient levels (nitrate nitrogen, phosphate, potassium, magnesium, calcium, ammonium, iron, and manganese) tested. The analysis tests shall show recommendations for soil additives or fertilizers to correct soil mixes’ deficiencies as necessary.
      b) Nutrient deficiencies shall be corrected at time of installation.

   3. Soluble salts measurement is less or equal to 2 mmho/cm.

   4. Percolation test to ensure adequate drainage and proper mixing of Compost as determined by Soils Engineer from testing agency.

   5. Toxic Substance content.

E. Per results of Soil Testing, bring Planting Mix to pH levels between 5.5 and 6.0 for plants and verify by follow-up testing. Lower pH by using elemental sulfur product. Peat moss or copper sulfate may not be used to lower pH.

2.14 STRUCTURAL SOIL
CU-STRUCTURAL SOIL® COMPONENTS (for use as subbase material under Paving Area)

A. Structural Soil Foundation Material: Shall conform to CU-Soil™, as patented by Cornell University, patent #5,849,069. The product shall be obtained from a licensed supplier and proof of such licensing shall be submitted to the DDC Resident Engineer prior to delivery. Tri-State licensed providers as of this date are East Coast Mines & Materials, Inc., East Quogue, NY, 631-653-5445; Long Island Compost, Yaphank, NY, 631-379-7830, Custom Material Solutions, LLC., Baptistown, NJ, 732-850-1760, Country View, Inc. Somerset, NJ, 732-560-8000; or Ascape Landscape, Blauvelt, NY, 845-353-6500. For further information on licensed providers or licensing requirements and application, contact Brian Kalter at Amereq Inc., New City, NY 800-832-8788 (patentholder rights granted to Amereq, Inc. by Cornell Research Foundation). Structural Soil components shall be mixed by the licensed producer to the following proportion:

<table>
<thead>
<tr>
<th>Component</th>
<th>Unit of Weight (Dry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed Stone</td>
<td>83%</td>
</tr>
<tr>
<td>Clay Loam</td>
<td>17%</td>
</tr>
<tr>
<td>Hydrogel</td>
<td>1 ounce per 200 pounds of stone</td>
</tr>
</tbody>
</table>

B. Crushed Stone: Shall be crushed granite or traprock; no limestone or sandstone shall be accepted. No recycled material shall be accepted. Stone shall meet the AASHTO/ASTM C 33 requirements for #4 crushed angular stone graded within the following limits:

Passing Sieve (dry analysis) Percent by Weight
- 2 inch: 100%
- 1½ inch: 90-100%
- 1 inch: 20-55%
- 3/4 inch: 0-15%
- 3/8 inch: 0-5%

Stone shall be clean and certified to meet NYCDOT aggregate soundness requirements for use in road construction. A single sized stone near one-inch (1") will be preferable to a wider size distribution or smaller single size stone fitting the general description.

C. Clay Loam: Shall be as determined by the USDA Classification System and mechanical analysis, as per ASTM D422. Clay loam shall be of uniform composition, without admixture of subsoil, and free of stones greater than one-half inch (1/2") diameter, leaves, roots, debris, toxic materials, or lumps or clods over one inch (1") diameter. It shall have been obtained from naturally well-drained areas that have never been previously stripped for topsoil and shall have a history of supporting satisfactory vegetative growth. It shall contain not less than two percent (2%) nor more than five percent (5%) organic matter, as determined by loss on ignition of oven-dried samples, dried to a constant weight at a temperature of 230°F, plus or minus 9°F.

Mechanical analysis for clay loam shall be as follows:

<table>
<thead>
<tr>
<th>Textural Class</th>
<th>Percent of Total Weight (Dry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>Less than 5%</td>
</tr>
</tbody>
</table>

Trees, Shrubs and Groundcover
Trees, Shrubs and Groundcover

Clay loam shall meet or be amended to meet the following chemical analysis criteria:

1. pH between 5.5 and 6.5.
2. Organic matter 2 - 5 percent by dry weight.
3. Nutrient levels as required by the testing laboratory recommendations for the types of plants to be grown in the structural soil.
4. Toxic elements and compounds below the US EPA Standards for Exceptional Quality Sludge, or local standards, whichever are more stringent.
5. Soluble salts less than 1.0 millimho per cm.
6. Cation exchange capacity (CEC) greater than 10.
7. Carbon/ Nitrogen ratio less than 33:1.

Clay loam shall be the product of a commercial processing facility specializing in production of stripped natural topsoil. No clay loam shall come from USDA classified prime farmland.

D. pH Adjustment: To lower the clay loam pH to acceptable levels, commercial granular ferrous sulfate, ninety-six percent (96%) pure sulfur may be added to lower soil pH above 6.5. To raise pH levels, the manufacturer may add agricultural limestone containing a minimum of eighty-five percent (85%) carbonates. Minimum gradation: 100% passing 10 mesh sieve, 98% passing 20 mesh sieve, 55% passing 60 mesh sieve, and 40% passing 100 mesh sieve.

E. Hydrogel: Shall be Gelscape®, a potassium propenoate-propenamide copolymer hydrogel, as manufactured by Amereq, Inc., New City, N.Y., or approved tested equivalent. No substitution is recommended, since small changes in the hydrogel structure greatly change the quality of the structural soil.

F. Uniformly blended urban tree mixture of crushed stone, clay loam and Gelscape® Hydrogel Tackifier, as produced by an Amereq-licensed company, mixed in the following proportion:

<table>
<thead>
<tr>
<th>Material</th>
<th>Unit of Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>specified crushed Stone</td>
<td>100 units dry weight</td>
</tr>
<tr>
<td>specified clay loam</td>
<td>20 – 25 units (to achieve minimum CBR of 50)</td>
</tr>
<tr>
<td>Gelscape® Hydrogel Tackifier moisture</td>
<td>0.035 units dry weight</td>
</tr>
</tbody>
</table>

ASTM D698/AASHTO T-99 optimum moisture
CU-STRUCTURAL SOIL® MIXING AND QUALITY CONTROL TESTING

A. All CU-Structural Soil® mixing shall be performed at the licensed producer’s yard using appropriate soil measuring, mixing and shredding equipment of sufficient capacity and capability to assure proper quality control and consistent mix ratios. No mixing of CU-Structural Soil® at the project site shall be permitted. 

Maintain adequate moisture content during the mixing process. Soils and mix components shall easily shred and break down without clumping. Soil clods shall easily break down into a fine crumbly texture. Soils shall not be overly wet or dry. The licensed producer shall measure and monitor the amount of soil moisture at the mixing site periodically during the mixing process.

B. Raw materials shall be mixed off-site, only at the licensed producer’s facility, on a flat asphalt or concrete paved surface to avoid soil contamination.

Should the independent laboratory test results of the clay loam reveal a need to amend it, to meet specifications, the amending materials should be added to the clay loam following the rates and recommendations provided by Amereq.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawn and existing exterior plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff of airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, and obtain Landscape Architect's acceptance of layout before planting. Make minor adjustments as may be required.

3.03 PLANTING BED ESTABLISHMENT

A. Around Existing Trees:

1. Loosen existing soil surface by hand to a depth required to plant shrubs and perennials.
2. Do not place more than 6 inches of topsoil or planting mix under dripline of existing trees.

3. Spread two-inch deep layer of Compost over soil. Mix thoroughly into top six inches of soil. Excavate and remove existing soil as required to maintain existing grades of landscape beds.

B. Newly Graded Subgrades– Not within Dripline of Existing Trees:

1. Loosen compacted subgrade, except around existing trees and exposed trees roots with a subsoil tool to a depth of 18 inches (500 mm) and with vertical trenches 24 inches (600 mm) apart. Run subsoil tool in two directions at right angles to each other.

2. Spread two-inch deep layer of topsoil over loosened subgrade. Mix thoroughly into top four inches of subgrade. Excavate and remove existing soil as required to maintain existing grades of landscape beds.

3. Spread topsoil to depths indicated but not less than required to meet finish grades after addition of amendments, light rolling and natural settlement. Do not spread if topsoil or subgrade is frozen, muddy, or excessively wet. Apply soil amendments and fertilizer on surface and mix thoroughly into topsoil.

4. Spread two-inch deep layer of Compost over topsoil. Mix thoroughly into top six inches of soil.

5. After light rolling and settlement, compact in 6-inch lifts and compact to 85% of maximum dry weight according to ASTM D 698, to depth required to meet grades, and elevations shown.

C. Finish Grade: Grade planting beds to a smooth, even surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

D. Stage installation of planting soil to avoid travel by equipment over placed topsoil or planting mix.

E. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.04 TREE AND SHRUB EXCAVATION

A. Pits: Excavate pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.

B. Use clean subsoil removed from excavations as backfill only after mixing with Planting Mix as specified.

C. Obstructions: Notify Landscape Architect if unexpected rock or other obstructions detrimental to trees or shrubs, are encountered in excavations.
1. Hardpan Layer: Drill 6-inch diameter holes into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

D. Fill excavations with water and allow to percolate out, before placing setting layer and positioning trees and shrubs.

E. Application of Mycorrhizae: Install one (1) Pack at bottom of planting pit per rootball for shrubs, and three (3) Packs at bottom of planting pit per Tree and according to manufacturer's written recommendations.

3.05 TREE AND SHRUB PLANTING

A. Set balled and burlapped stock plumb and in center of pit with top of ball at same elevation relative to ground level as in nursery.
   1. If soil is dry, moisten prepared planting areas before planting. Water thoroughly and allow surface moisture to dry before planting. Do not create muddy soil conditions.
   2. Do not remove burlap from balls. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
   3. Place planting soil mix around root ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Water again after placing and tamping final layer of backfill.

B. Set container-grown stock plumb and in center of pit with top of ball raised above adjacent finish grades as indicated.
   1. Carefully remove containers so as not to damage root balls.
   2. Cut pot bound roots to prevent future root girdling.
   3. Place stock on setting layer of compacted planting soil.
   4. Place planting soil mix around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Water again after placing and tamping final layer of backfill.

C. Mulching: Apply mulches of types indicated and to thickness and surface indicated. Do not place mulch against trunks or stems.

3.06 TREE AND SHRUB PRUNING

A. Do not prune trees and shrubs unless directed by Landscape Architect.

B. Unless otherwise directed by Landscape Architect, do not cut tree leaders; remove only injured or dead branches.

3.07 GROUNDCOVER AND PERENNIAL PLANTING

A. Do not remove plants from containers until immediately before planting.
B. Space and locate plants as reviewed with Landscape Architect on-site and as shown on Drawings and Plant Schedule.

C. Dig holes large enough to allow for spreading of roots and backfill with planting soil.

D. Immediately before setting plants, dip plant rootball into solution of root dip gel and water as recommended by manufacturer.

E. Work soil around roots to eliminate air pockets and tamp firm to prevent settlement. Leave a slight saucer indentation around plants to hold water. Water each plant and entire area of plant bed thoroughly after planting, taking care not to cover crowns of plants with wet soil.

3.08 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds, and other areas indicated to settled thickness indicated on Drawings. Do not mulch against trunks.

3.09 INSTALLATION OF MISCELLANEOUS MATERIALS

A. Apply antidesiccant, if needed, using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.

1. If deciduous trees or shrubs are moved in full-leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

3.10 INSTALLATION OF CU-STRUCTURAL SOIL®

A. Install CU-Structural Soil® in 6 inch lifts and compact each lift.

B. Compact all materials to 95% Proctor Density from a standard compaction curve AASHTO T 99 (ASTM D 698). No compaction shall occur when moisture content exceeds maximum as listed herein. Delay compaction if moisture content exceeds maximum allowable and protect CU-Structural Soil® during delays in compaction with plastic or plywood as directed by the engineer.

C. Bring CU-Structural Soil® to finished grades as shown on the drawings. Immediately protect the CU-Structural Soil® from contamination by toxic materials, trash, debris, water containing cement, clay, silt or materials that will alter the particle size distribution of the mix with plastic or plywood as directed by the engineer.

D. The engineer may periodically check the material being delivered, prior to installation for color and texture consistency with the approved sample provided by the installing contractor as part of the submittal for CU-Structural Soil®. If the engineer determines that the delivered CU-Soil™ varies significantly from the approved samples, the engineer shall contact the licensed producer.

E. Engineer shall ensure that the delivered structural soil was produced by the approved CU-Soil™ licensee by inspecting weight tickets showing source of material.
F. CU-Soil™ should not be stockpiled long-term. Any CU-Soil™ not installed immediately should be protected by a tarp or other waterproof covering.

3.11 FINE GRADING OF CU-STRUCTURAL SOIL®

A. After the initial placement and rough grading of the CU-Structural Soil® but prior to the start of fine grading, the installing contractor shall request review of the rough grading by the engineer. The installing contractor shall set sufficient grade stakes for checking the finished grades.

B. Adjust the finish grades to meet field conditions as directed.

Provide smooth transitions between slopes of different gradients and direction. Fill all dips with CU-Soil™ and remove any bumps in the overall plane of the slope.

1. The tolerance for dips and bumps in CU-Structural Soil® areas shall be a 3” deviation from the plane in 10’.

2. All fine grading shall be inspected and approved by the engineer prior to the installation of other items to be placed on the CU-Structural Soil®.

C. The engineer will inspect the work upon the request of the installing contractor. Request for inspection shall be received by the engineer at least 10 days before the anticipated date of inspection.

3.12 CLEANUP AND PROTECTION

A. During planting work, keep pavements clean and work area in an orderly condition.

B. Protect plantings 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.

3.13 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil and recycle and compost all suitable soil, trash, and debris. Legally dispose of any other materials not suitable for recycling and composting off of the Owner's property.

END OF SECTION 329300
SECTION 334600 - STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe and fittings.
   2. Stormwater inlets.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
   B. Field quality-control reports.

1.3 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of service.
   2. Do not proceed with interruption of service without Construction Manager's and Owner's permission.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252M, Type S, with smooth waterway for coupling joints.

2.2 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.
   2. Class III, Wall B.
2.3 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.4 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
   a. Invert Slope: 2 percent through manhole.
2. Benches: Concrete, sloped to drain into channel.
   a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
   2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK
   A. Excavation, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 PIPING INSTALLATION
   A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

   B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

   C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

   D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

   E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

   F. Install gravity-flow, nonpressure drainage piping according to the following:
      1. Install piping pitched down in direction of flow.
      2. Install piping with 36-inch minimum cover.
      3. Install PE corrugated sewer piping according to ASTM D 2321.
      4. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
      5. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:
   1. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.

3.4 CATCH BASIN INSTALLATION

A. Set frames and grates to elevations indicated.

3.5 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to requirements of authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.
   5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
      a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
      b. Option: Test plastic piping according to ASTM F 1417.
      c. Option: Test concrete piping according to ASTM C 924.

C. Leaks and loss in test pressure constitute defects that must be repaired.
D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 334600
SECTION 129300 SITE FURNISHINGS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS
   A. The general provisions of the Contract including General Conditions and Supplementary General Conditions and General Requirements (if any) apply to the work specified herein.

1.02 DESCRIPTION OF THE WORK
   A. Provide equipment as shown on the plan; furnish all labor, materials and equipment required for a complete installation.

1.03 SUBMITTALS
   A. Manufacturer's Data:
      1. For site furnishings, complete erection drawings shall be prepared by the Contractor and furnished for approval prior to shipment. Drawings shall include design layouts of materials to be furnished, including over-all dimensions, platform locations, heights, accessory details, methods of assembly and hardware data, and color samples.

1.04 PRODUCT DELIVERY, STORAGE & HANDLING
   A. Deliver cartoned or crated to provide protection during transit and storage in a dry and clean location, off the ground, and remove materials which are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials.
   B. All site furnishings shall be delivered by unit, to the extent practical, and each package shall contain all material necessary for complete assembly. Units are to be secured with non-ferrous strapping utilizing edge-protectors on all corners. Units to be paper-wrapped with waterproof non-bleeding beamwrap or tarpaulins.
   C. Inspect on delivery for damage report in writing to Architect if this condition exists.

PART 2 PRODUCTS

2.01 Benches
   Base Bid: Concrete Benches shall be manufactured by Wausau Made, www.wausaumade.com, Model: TF 5117, size 48" x 18" x 18" with surface mounted anchoring. Phone number 800-388-8728.

2.02 Bollards: Base Bid: Bollards shall be manufactured by Maglin, Model: MTB650-B4 Color Black. Phone number 800-716-5506. www.maglin.com

2.03 Bike Rack Base Bid: Bike Rack shall be manufactured by Landscape Forms, Model: Bola. Color: Black. Surface Mount Phone: 800.521.2546 www.landscapeforms.com

Salvaged: Bike Rack shall be manufactured by Creative Pipe, Model: Lightning Bolt LR Series. Surface Mount Phone: 800-644-8467. www.creativepipe.com


2.05 Fixed Table & Chair Combination Base Bid: Table & Chair Combination shall be manufactured by Landscape Forms, Model: Carousel Casual height, 4-seats hoop, Solid Powder Coat Tabletop, Without umbrella hole, Surface Mount, Color: Black, location: east corner of Robinson hall. Phone number:800.521.2546
http://www.landscapeforms.com

Table & Chair Combination shall be manufactured by Landscape Forms, Model: Carousel Standing height, 4-seats backless, grid seat, Solid Powder Coat Tabletop, Without umbrella hole, Surface Mount, Color: Black, location: Wilson Entrance and Lower Wilson. Phone number:800.521.2546
http://www.landscapeforms.com

2.06 Skate Deterrent Base Bid: Skate Deterrent shall be manufactured by Grind to a Halt, Model: Hemisphere “Hemi” Grinderminder. Phone: 630.365.2375 https://grindtoahalt.com Location: Lower Wilson Small Amphitheatre. Install as per manufacturers direction.

2.07 Tree Grate Frame Base Bid: Recycled Iron 60” square Tree Grate from University campus.

Add Alternate No. 2: Tree Grate Frame for 60” Square Tree Grate shall be manufactured by Neenah Foundry Company, Model: R-8742-A1, Adirondack collection. Phone: 800-558-5075 http://www.nfco.com Confirm compatibility with salvaged tree grates prior to purchase.
PART 3 EXECUTION

3.01 COORDINATION

A. Installer must review installation procedures and coordinate with the contractor and other contractors with subcontractors who would be affected by the installation of the site furnishings.

B. Examine surfaces and conditions to which this work is to be attached. Starting on the work shall imply acceptance of the surfaces and conditions to perform the work specified.

3.02 INSTALLATION

A. Except as otherwise specified, all work shall conform and be installed to manufacturer's directions for securing seats to pavement.

B. All final adjustments and cleaning shall be made by the manufacturer's representatives.

C. Install benches and tables where indicated on plans.

3.03 GUARANTEE

A. The Contractor shall furnish and guarantee covering the work under this section against defective material and inferior workmanship for a period of one year in accordance with the General Conditions.

END OF SECTION
SECTION 313600 WIRE MESH GABION BASKETS

PART 1 GENERAL

1.1 RELATED SECTIONS
1. Section 312000 - Earthwork

1.2 REFERENCES
1. American Society for Testing and Materials (ASTM)
4. ASTM A A974-97 for Gabion Wire Baskets.

PART 2 PRODUCTS

2.1 MATERIALS
Gabion baskets:
1. Factory fabricated so that sides, ends, lid and internal diaphragms readily assemble at site into rectangular baskets of sizes as indicated.
2. Single unit construction or with joints having strength and flexibility equal to that of mesh.
3. When length exceeds horizontal width, provide diaphragms of same mesh as gabion walls to divide basket into equal cells of length not more than horizontal width.
4. Wire mesh gabions:
   a. Gabions shall consist of rectangular wire mesh formed containers filled with broken concrete. Gabions will conform to one of the following types:
   b. Woven mesh-Nonraveling, double twisted, hexagonal wire mesh consisting of two wires twisted together in two 180-degree turns.
   c. Gabions-Gabions shall be furnished as baskets or mattresses as specified in section 8. Baskets and mattresses shall be fabricated within a dimension tolerance of plus or minus 5 percent.
   d. Wire mesh to be uniform rectangular pattern wire woven in triple twist pattern with openings of approximately 3” x 3” and fabricated to be non-raveling. Perimeter edges of mesh to be securely selvedged so that joints formed by connecting selvedges are as strong as body of mesh.
1. Wire to have following dimensions:
   a. Mesh: minimum .12 inches diameter.
   b. Selvedges: 3.8 mm diameter.
   c. Binding: 2.0 mm diameter.

2. Wire: hot dip galvanized with minimum coverage of 260 g/m to CSA G164.

3. Interlocking wire fasteners: galvanized steel to ASTM A 764, finish 1, class 1, type 3.

Geogrid gabions:
1. Geogrid mesh to be rigid type, uniform, square pattern, non corrosive, high density polyethylene with inhibitors added to resist deterioration by ultra-violet and heat exposure. Geogrid openings to be 50 x 50 mm.

2. Geogrid to have following mechanical properties: Tensile modulus at 2% elongation: to ANSI/ASTM D638M, modified to manufacturer's recommendations, minimum 290 kN/m. Junction strength: to ANSI/ASTM D 638M, modified to manufacturer's recommendations, minimum 90% of single rib strength.

3. Gabions shall be fabricated, assembled, and installed in accordance with the nominal wire sizes and dimensions shown in tables 64-1 and 64-2, using the following materials unless otherwise specified

4. Wire for fabrication and assembly shall be hot-dipped galvanized. The wire shall have a minimum tensile strength of 60,000 pounds per square inch. Galvanized steel wire shall conform to ASTM A 641, class 3, soft temper.

2.2 STONE FILL:
1. Recycled Concrete pieces to be reclaimed from the Wilson Hall Plaza.
2. Minimum 3.75 inches to maximum 8 inches dimension for individual stones.

PART 3 EXECUTION

3.1 INSTALLATION
1. Install gabions to lines and grades as indicated. Follow manufacturer's instructions in assembling baskets.

2. Excavate for and backfill behind gabions in accordance with Section 312000 – Earthwork.

3.2 PLACING GABIONS
1. Wherever possible, place baskets in position prior to filling with stones.
2. Join adjacent baskets together at corners as recommended by manufacturer, so that joints are as strong as mesh.

3.3 FILLING BASKETS

1. Tension geogrid gabions according to manufacturer's instructions before filling with stone. Do not release wall tension until sufficient stone fill has been placed to prevent wall slackening.

2. On exposed faces of gabions, place stones by hand with flattest surfaces bearing against face mesh to produce satisfactory alignment and appearance.

3. For wire mesh gabions, fill gabion cells in lifts not exceeding 300 mm and connect opposite walls with 2 tie wires after each lift.

4. The gabions shall be carefully filled with rock by machine or hand methods to ensure alignment, avoid bulges, and provide a compact mass that minimizes voids. Machine placement requires supplementing with hand work to ensure the desired results. The cells in any row shall be filled in stages so that the depth of rock placed in any one cell does not exceed the depth of rock in any adjoining cell by more than 12 inches. Along the exposed faces, the outer layer of stone shall be carefully placed and arranged by hand to ensure a neat, compact placement with a uniform appearance.

5. The last layer of rock shall be uniformly leveled to the top edges of the gabions. Lids shall be stretched tight over the rock filling using only approved lid closing tools as necessary. The use of crowbars or other single point leverage bars for lid closing is prohibited as they may damage the baskets. The lid shall be stretched until it meets the perimeter edges of the front and end panels. The gabion lid shall then be secured to the sides, ends, and diaphragms with spiral binders, approved alternate fasteners, or lacing wire wrapped with alternating single and double half-hitches in the mesh openings.

6. Any damage to the wire or coatings during assembly, placement, and filling shall be repaired promptly in accordance with the manufacturer's recommendations or replaced with undamaged gabion baskets.

7. Where shown on the plans place limestone capstone flush with top of filled gabion basket to ensure a level surface. Any damage to the capstone during assembly and placement shall be repaired promptly in accordance with the manufacturer's recommendations or replaced with undamaged gabion baskets and capstone.
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:
   1. Aluminum tube railings.
   2. Stainless-steel tube railings.
   3. Stainless steel lighted railing.

B. Related Requirements:
   1. Section 321613 Cast in Place Concrete.

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 anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of mechanically connected railings.
   2. Railing brackets.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.
1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
   a. Show method of connecting and finishing members at intersections.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.
B. Welding certificates.
C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   2. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Pipe and Tube Railings:
   1. Julius Blum or approved equal.

B. Stainless-Steel Pipe and Tube Railings:
   1. Intense Lighting, Model no. II-IVR15-SPI, stainless steel 316.
      Location: Lighted rail on steps.

C. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ft applied in any direction.
      b. Concentrated load of 200 lbf applied 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 applied horizontally on an area of 1 sq. ft.
      b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.

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: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Tubing: ASTM B 221 Alloy 6063-T5/T52.

   1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

D. Drawn Seamless Tubing: ASTM B 210 Alloy 6063-T832.

2.5 STAINLESS STEEL

A. tubing: ASTM A 554, Grade MT 316L.

B. Pipe: ASTM A 312/A 312M, Grade TP 316L.

C. Castings: ASTM A 743/A 743M, Grade CF 8M or CF 3M.

2.6 FASTENERS

A. General: Provide the following:
   1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
   2. Aluminum Railings: Type 316 stainless-steel fasteners.
   3. Stainless-Steel Railings: Type 316 stainless-steel fasteners.
   4. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
   2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
   3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.


2.7 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum and stainless-steel 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: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

G. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

H. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

I. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

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

K. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.
2.8  FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. 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.

K. Form Changes in Direction as Follows:
   1. As detailed.
   2. By radius bends of radius indicated.
L. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of railing members with prefabricated end fittings.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

2.9 ALUMINUM FINISHES

A. 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 unacceptable. 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.

B. Mill Finish: AA-M12, nonspecular as fabricated.


D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.


2.10 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines, or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches.

C. Stainless Steel Tubing Finishes:

2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
3. Polished and Buffed Finish: 320-grit finish followed by buffing to a high luster finish.
D. Stainless Steel Sheet and Plate Finishes:
   1. Directional Satin Finish: ASTM A 489/A 480, No. 4.

E. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

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

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
   1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
   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.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
   1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

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 beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch 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 flange of same metal as post, attached to post with set screws.

D. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.

E. 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 aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
2. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
3. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

B. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3.6 ADJUSTING AND CLEANING

A. Clean aluminum and stainless steel 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 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

3.7 PROTECTION

A. Protect finishes of 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 260500 COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Electrical equipment coordination and installation.
   2. Sleeves for raceways and cables.
   3. Sleeve seals.
   5. Backboards.
   6. Common electrical installation requirements.

1.2 REFERENCES

A. National Electrical Contractors Association (NECA):
   1. NECA 1 – Standard Practice for Good Workmanship in Electrical Contracting.

B. Nation Electrical Testing Association (NETA):

C. National Fire Protection Association (NFPA):
   2. NFPA 70E – Electrical Safety in the Workplace.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. Furnish: to purchase, procure, acquire and deliver; complete with related accessories.

C. Install: to erect, mount and connect; complete with related accessories.

D. Provide: to Furnish and Install.

E. Wiring: raceways, fittings, supports, boxes, conductors or cable, and related items.
1.4 SUBMITTALS
   A. Product Data: For sleeve seals.

1.5 BASIC ELECTRICAL METHODS
   A. The drawings are schematic and diagrammatic. Use judgment and care to install electrical Work to function properly and fit within building construction and finishes. Electrical conductors, conduit, devices, components, and accessories, even if not specifically shown or specified, which are required for any device or system to produce a complete and operative system are required to be provided.

   B. Branch circuit wiring is not indicated on the drawings. Numerals adjacent to symbols for equipment, devices, lighting fixtures, motors, and etcetera denotes the branch circuit to which the item is to be connected. Branch circuit numbers that are contained within parenthesis denote a multiple pole branch circuit breaker. Lower case letters adjacent to a device or lighting fixture symbols denote switch control.

   C. Branch circuits are scheduled unless otherwise noted. Do not connect or share the ungrounded (neutral) conductors of different branch circuits. Do not splice branch circuit conductors in any switchboard, panelboard, enclosed switch or circuit breaker.

   D. The exact locations of outlet devices are to be determined from dimension on drawings, manufacturer's shop drawings, or as may be determined in the field. Do not scale drawings for exact location of any item. Verify item mounting heights as required by project conditions and equipment to be served prior to rough-in.

   E. Route conduits and wiring associated with new equipment and systems above ceilings, in existing chases, and concealed within building structure.

   F. Seal and make permanently watertight penetrations by electrical raceways or equipment through roofs, exterior walls or floors.

   G. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and NFPA 70.

   H. Remove existing equipment, lighting fixtures, switches, and receptacles as required to facilitate new installation and as indicated on the drawings. Remove existing wiring and conduit serving items to be removed. Conduit in inaccessible areas shall be cut off below finished surfaces and existing surface patched to match existing. Provide blank plates on existing flush mounted outlet boxes that will be abandoned. Remove all abandoned conductors from raceways.

1.6 COORDINATION
   A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. To connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

D. Coordinate sleeve selection and application with selection and application of firestopping.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping.

2.2 SLEEVE SEALS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Glass reinforced plastic. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 BACKBOARDS

A. Description: ¾-inch, Grade AC Plywood, finished on one side.
B. Dimensions: As indicated on drawings.
C. Backboard shall be painted on all sides including edges with two coats of fire-retardant black paint.
D. Secure backboards to walls in accordance with Division 26 Section “Hangers and Supports for Electrical Systems.”

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. The electrical installation shall comply with all applicable Codes, Regulations and Standards governing the Project Site including:
   2. The New Jersey State Uniform Construction Code (UCC).
   4. Americans with Disabilities Act (ADA).
   5. Architectural Barriers Act (ABA).
   7. The requirements, regulations and standards of the Electrical Utility Company.
B. All work shall be performed safely and in compliance with the current requirements of:
   1. Federal Occupational Safety and Health Act (OSHA) including:
   2. NFPA 70E – Standard for Electrical Safety in the Workplace
C. Comply with manufacturer's published instructions for delivery, storage, protection and installation of electrical equipment and materials.

D. Comply with NECA 1.

E. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

F. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

G. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

H. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between the raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

END OF SECTION 260500
SECTION 260519  LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Common Work Results for Electrical" for common electrical installation requirements and products.
2. Division 26 Section "Identification for Electrical Systems" for conductor and cable identification requirements and products.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alcan Products Corporation; Alcan Cable Division.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.
B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types RHH, RHW-2, THHN, THWN-2, XHHW-2, USE-2.

D. Multi-conductor Cable: Comply with metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Feeder wiring installed exposed in interior locations shall consist of Type THHN-THWN-2, single conductors in raceway.

B. Feeder wiring installed concealed in interior locations shall consist of Type THHN-THWN-2, single conductors in raceway or Type MC cable.

C. Feeder wiring installed underground or in outdoor locations shall consist of Type RHW-2, THWN-2 or XHHW-2 single conductors in raceway.

D. Branch Circuit wiring installed exposed in interior locations shall consist of Type THHN-THWN-2, single conductors in raceway.

E. Branch Circuit wiring installed concealed in interior locations shall consist of Type THHN-THWN-2, single conductors in raceway or Type MC cable.
F. Branch Circuit wiring serving lighting fixtures and installed concealed in interior locations shall consist of Type THHN-THWN-2, single conductors in raceway; or Type MC cable.

G. Branch Circuit wiring installed underground or in outdoor locations shall consist of Type RHW-2, THWN-2 or XHHW-2 single conductors in raceway.

H. Class 1 and 2 Control Circuits: Type THHN-THWN-2 in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Concel cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519
SECTION 260526  GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

B. Related Sections include the following:

   1. Division 26 Section "Common Work Results for Electrical” for common electrical installation requirements and products.
   2. Division 26 Section "Identification for Electrical Systems” for conductor and cable identification requirements and products.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

   4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet in length.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger, unless otherwise indicated.

B. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   3. Connections to Ground Rods: Bolted connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Handholes: Install a driven ground rod through handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. Provide No. 6 AWG bare, tinned-copper bonding conductor between ground rod and the equipment ground conductors.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.

C. Bonding Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.
   3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526
SECTION 260529  HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

B. Related Sections include the following:
   1. Division 26 Section "Common Work Results for Electrical" for common electrical installation requirements.

1.2 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five (5) times the applied force.

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Equipment supports.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.
1.5 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

   1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

      a. 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. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.


2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for raceways as scheduled in NECA 1, where its Table 1 lists maximum spacing for raceways less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single or two bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-inch and smaller raceways serving branch circuits, communication systems or electronic safety and security systems above suspended ceilings.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements unless otherwise specified in this Section.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 pounds.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Beam clamps.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529
SECTION 260533  RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes raceways, fittings, boxes, enclosures, cabinets, post mounted receptacle assemblies and underground handholds and boxes for electrical wiring.
B. Related Sections include the following:
   1. Division 26 Section "Common Work Results for Electrical" for common electrical installation requirements and products.

1.2 SUBMITTALS
A. Product Data: For surface raceways, wireways and fittings, handholes, floor boxes, poke-thru devices, hinged-cover enclosures, and cabinets.
B. Shop Drawings: For handholes, custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.
C. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.3 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. AFC Cable Systems, Inc.
   2. Alflex Inc.
   3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
7. Maverick Tube Corporation.

B. Rigid Metal Conduit (RMC): Rigid galvanized steel (RGS), ANSI C80.1.

C. Electrical Metal Tubing (EMT): ANSI C80.3.

D. Flexible Metal Conduit (FMC): Zinc-coated steel.

E. Liquid-tight Flexible Metal Conduit (LFMC): FMC with polyvinyl chloride jacket.

F. Fittings for conduit and EMT shall be NEMA FB 1 type; listed for type and size raceway with which used, and for application and environment in which installed.

G. Fittings for EMT shall be set-screw or compression type.

H. Fitting for RGS conduit shall be threaded.

I. Joint compound for RGS shall be listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. Rigid Polyvinyl Chloride Conduit (PVC): NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. Liquid-tight Flexible Nonmetallic Conduit (LFNC): UL 1660.

D. Fittings for PVC: NEMA TC 3; match to conduit type and material.
E. Fittings for LFNC: UL 514B.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
7. RACO; a Hubbell Company.
10. Spring City Electrical Manufacturing Company.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum or galvanized, cast iron with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, steel with continuous-hinge cover with flush latch, finished inside and out with manufacturer’s standard enamel unless otherwise indicated.

G. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.4 POST MOUNTED OUTDOOR RECEPTACLE ASSEMBLIES

A. Basis-of Design Product: Subject to compliance with requirements, post mounted outdoor receptacle assemblies shall be the GPD19 Gard-N-Post as manufactures by Arlington Industries, Inc. or equivalent product.
B. Receptacle assemblies post shall be one piece, constructed with heavy-duty, UV-rated plastic.

C. The plastic post shall be of the color selected by the landscape architect. The colorant shall run throughout the plastic post to eliminate chipping or color loss.

D. Receptacle assemblies shall be listed for outdoor use and meet the code requirements extra-duty.

E. Receptacles assemblies shall be provided with a NEMA 5-15R, GFCI, weather-resistant type, duplex receptacle; face plate; and extra-duty, weatherproof while in use, clear plastic cover.

2.5 HANDHOLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Quazite PT Style handholes for exterior underground wiring as manufactured by Hubbell or equivalent products of one of the following:
   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. CDR Systems Corporation.
   d. NewBasis.

B. Handholes for exterior underground wiring shall be constructed of gray polymer concrete and provided with polymer concrete covers.

C. Handholes shall be UL Listed and conform to all test provisions of ANSI/SCTE 77 for UL Tier 8.

D. Type 1 Handholes shall be nominally 13-inches wide by 24-inches long by 18-inches deep and have an open bottom.

E. Handholes shall be provided with heavy duty covers having a non-skid finish with a minimum coefficient of friction of 0.50 and suitable for applications subject to occasional non-deliberate vehicular traffic.

F. Covers shall be provided with molded lettering indicating the type of service or wiring enclosed.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Conduits Subject to Physical Damage: RGS.
   2. Conduits Not Subject to Physical Damage: RGS or EMT.
   3. Underground Conduit: PVC.
   4. Connection to Vibrating Equipment shall match conduit type: LFMC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: RGS or EMT.
2. Exposed and Subject to Physical Damage: RGS.
3. Concealed in Ceilings and Interior Walls and Partitions: RGS or EMT.
4. Connection to Vibrating: FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: RGS.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Section are stricter.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. All holes made in floor assemblies shall be fully coordinated with the existing field conditions and core-drilled in accordance with the manufactures instructions.

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of four 90-degree bends in any conduit run.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

I. Threaded Conduit Joints, Exposed to Wet, Damp, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install line in empty raceways. Use ¼-inch polypropylene line. Leave at least 12 inches of slack at each end of pull wire.

L. Install raceway sealing fittings at suitable, and accessible locations and fill them with listed sealing compound where required by NFPA 70.

M. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed lighting fixtures, vibrating equipment, transformers and motors.
N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
   1. Excavate trench bottom to provide firm and uniform support for conduit.
   2. Install controlled backfill.
   3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
   4. Install manufactured elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Concrete encase elbows for stub-up ducts throughout the length of the elbow.

3.4 INSTALLATION OF POST MOUNTED OUTDOOR RECEPTACLE ASSEMBLIES

A. Post mounted outdoor receptacle assemblies shall be installed with the bottom of the receptacle device a minimum of 4-inches above the finished grade unless otherwise noted or indicted.

3.5 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholds and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Support units on a level bed of crushed stone or gravel compacted to same density as adjacent undisturbed earth.

C. Set units so the cover surface will be flush with finished grade in paved areas and 1-inch above finished grade in all other areas.

D. Field-cut openings for conduits according to enclosure manufacturer’s written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

END OF SECTION 260533
SECTION 260553  IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification of power and control cables.
2. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
7. Miscellaneous identification products.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.


D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Tape:
   1. 3-inch wide, detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side and suitable for direct-burial service.
   2. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical power, control and communications lines.
   3. Printing on tape shall be permanent and shall not be damaged by burial operations.
   4. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:
1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: CAUTION – ELECTRIC LINE BURIED BELOW.
3. Inscriptions for Orange-Colored Tapes: CAUTION – COMMUNICATIONS CABLE BURIED BELOW.

2.4 WARNING LABELS AND SIGNS


B. Factory Applied, Self-Adhesive Warning Labels: Factory-printed and applied, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:
   1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
   2. Grommets in corners for mounting.

D. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.5 INSTRUCTION SIGNS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background.

B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background.

C. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background.
2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade.

3.2 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
IDENTIFICATION FOR ELECTRICAL SYSTEMS

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG.

b. Colors for 208Y/120-Volt Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Grounded Conductor (Neutral): White

c. Colors for 480Y/277-Volt Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Grounded Conductor (Neutral): Gray

B. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

C. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.


1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring; and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Factory applied Self-adhesive warning labels or Baked-enamel warning signs.

2. Apply to exterior of door, cover, or other access.

G. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
   a. Indoor Equipment: Adhesive film label or Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Contactors.
   e. Remote-controlled switches and control devices.

END OF SECTION 260553
SECTION 260923  LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following lighting control devices:
   1. Outdoor photoelectric switches.
   2. Lighting contactors.

B. Related Sections include the following:
   1. Section 260519 – Low-Voltage Electrical Power Conductors and Cables for power wiring.
   2. Section 262726 – Wiring Devices for general use snap switches, occupancy sensing line-voltage wall switches, timer switches, and wall and cover plates.

1.2 SUBMITTALS

A. Product Data: Provide product data sheets clearly marked to indicated the product, features and/or options to be provided for each type of product indicated.

B. Shop Drawings:
   1. Dimensional drawings or details for each type of product indicated.
   2. Typical wiring diagrams for each type of product indicated.

C. Field quality-control test reports.

D. Operation and Maintenance Data: Provide operation and maintenance manual for each type of product.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain all networked digital lighting control products from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 COORDINATION

A. Coordinate the layout and installation of lighting control components and devices with other construction. Provide access panels for all lighting control components and devices located within inaccessible wall partitions or ceiling assemblies.
PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Tork 2100 Series, specification grade photocell for conduit mounting or a comparable product by one of the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Intermatic, Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Square D; Schneider Electric.
5. Watt Stopper (The).

B. Photoelectric switches shall be weatherproof and operate at 120 volts.

2.2 LIGHTING CONTACTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Square-D Class 8903, Type LX, multi-pole lighting contactor or a comparable product by one of the following:

2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
4. GE Industrial Systems; Total Lighting Control.
5. Siemens.
6. TORK.

B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.3 CONDUCTORS AND CABLES

A. Power wiring for lighting control products shall comply with requirements of Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

A. Identify components, and power and control wiring according to Section 260553 - Identification for Electrical Systems.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
   2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.4 DEMONSTRATION

A. Demonstrate and train the Owner's personnel use and operation of the lighting control devices.

END OF SECTION 260923
SECTION 262726  WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. General use receptacles.
   2. General use snap switches.
   3. Wall and cover plates.

B. Related Sections include the following:
   1. Section 260923 - Lighting Control Devices for photocells, and lighting contactors.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For wiring devices to include in all manufacturers’ packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

A. Source Limitations: Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 GENERAL USE RECEPTACLES

A. Basis-of-Design: Subject to compliance with requirements, provide the indicated Legrand/Pass & Seymour products or equivalent product by one of the following:
   1. Eaton,
   2. Hubbell Wiring Device-Kellems

B. GFCI, 15 Ampere, Weather-Resistant Duplex Receptacles: TradeMaster/spec grade weather-resistant self-test GFCI duplex receptacles, Catalog No. 1597TR, 15 Ampere, 125 volt, with (2) NEMA 5-15TRWR outlets, and self-test diagnostics with device fail LED indicator.

2.2 GENERAL USE SNAP SWITCHES

A. Basis-of-Design: Subject to compliance with requirements, provide the indicated Legrand/Pass & Seymour products or equivalent product by one of the following:

1. Eaton.
2. Hubbell Wiring Device-Kellems


2.3 WALL AND COVER PLATES

A. Manufacturer: Subject to compliance with requirements, provide wiring device wall and cover plate products of the same manufacture as the corresponding wiring device products.

B. Wall Plates: Standard sized, single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with exposed head colored to match plate finish.
2. Material for Finished Spaces: Type 302 Stainless Steel.
3. Material for Utility and Support (ie. Mechanical, Electrical and Storage) Spaces: Type 302 Stainless Steel or Galvanized steel.

C. Cover Plates: Single and combination types to match corresponding wiring devices.

1. Wet and Damp Locations: Heavy-duty die-cast zinc or Heavy cast aluminum weatherproof cover with single self-closing lids and gray finish.

D. Wiring Device Colors: Wiring device catalog numbers indicated in the paragraphs above do not designate device colors. Provide wiring devices having the following colors unless otherwise indicated or required by Code or device listing:


PART 3 - EXECUTION

3.1 WIRING DEVICE STYLE APPLICATIONS

A. Finished Spaces: Standard style.
B. Utility and Support (ie. Mechanical, Electrical and Storage) Spaces: Standard style.

C. Unfinished Spaces: Standard style.

3.2 WIRING DEVICE TYPE APPLICATIONS

A. All general use, 125 volts, 15 and 20 amperes, receptacle devices provided in damp or wet locations shall be ground fault circuit interrupting (GFCI) and weather-resistant (WR) type unless otherwise indicated, or required by Code.

B. All general use, 125 volts, receptacle devices served by a 15 ampere branch circuit or a 20 ampere branch circuit serving more than one receptacle or outlet shall be 15 ampere devices with NEMA 5-15R outlets unless otherwise indicated, or required by Code.

C. All general use, 125 volts, receptacle devices served by a dedicated 20 ampere branch circuit and serving no other receptacles or outlets shall be a 20 ampere device with NEMA 5-20R outlets unless otherwise indicated, or required by Code.

D. All general use, 125 volts, snap switches served by a 15 ampere branch circuit may be 15 or 20 ampere devices.

E. All general use, 125 volts, snap switches served by a 20 ampere branch circuit shall be 20 ampere devices.

3.3 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

D. Device Installation:
1. Install general use 125 volt, wall recessed or mounted snap switch devices at 45-inches above the finished floor to the center of the device and a maximum of 48-inches above the finished floor to the top of the device unless otherwise indicated, or required by Code.
2. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
3. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
4. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
5. Connect devices to branch circuits using pigtails that are not less than 8-inches in length.
6. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
7. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. General Use Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Wall Plates: Do not use oversized, jumbo or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent device under single, multi-gang wall or cover plates.

H. Adjust locations of floor service outlets to suit arrangements of partitions and furnishings.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections, and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for General Use Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 volts.
2. Percent Voltage Drop under 15-A Load: A value of 5 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
SECTION 265600 EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Exterior luminaires.
2. Poles and accessories.

1.3 DEFINITIONS

A. CRI: Color-rendering index.
B. Luminaire: Complete lighting fixture.
C. Pole: Luminaire support structure.
D. Standard: Same definition as "Pole" above.

1.4 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
6. Drivers.
7. Light engines, including life, output, and energy-efficiency data.
8. Materials, dimensions, and finishes of poles.
9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
10. Anchor bolts for poles.

B. Shop Drawings:
1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
2. Wiring Diagrams: Power and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


D. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Light engines and drivers: Replace light engines and drivers that fail within 12 months from date of Substantial Completion; furnish replacement light engines and drivers that fail within the second 12 months from date of Substantial Completion.
5. **Warranty Period for Poles:** Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than five years from date of Substantial Completion.

### 1.8 EXTRA MATERIALS

**A.** Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. **Light Engines:** 1 for every 10 of each type and rating installed. Furnish at least one of each type.
2. **Glass and Plastic Lenses, Covers, and Other Optical Parts:** 1 for every 10 of each type and rating installed. Furnish at least one of each type.
3. **Drivers:** 1 for every 10 of each type and rating installed. Furnish at least one of each type.
4. **Globes and Guards:** 1 for every 10 of each type and rating installed. Furnish at least one of each type.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

**A.** In Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. **Manufacturers:** Subject to compliance with requirements, provide products by the manufacturers specified.

#### 2.2 LUMINAIREs, GENERAL REQUIREMENTS

**A.** Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

**B.** Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

**C.** Metal Parts: Free of burrs and sharp corners and edges.

**D.** Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

**E.** Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

**F.** Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

N. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.3 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood or steel.
2.4 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

B. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

C. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

D. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

E. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.5 POLE ACCESSORIES

A. Duplex Receptacle: 120 V, 20 A in a weatherproof assembly complying with Division 26 Section "Wiring Devices" for ground-fault circuit-interrupter type.

B. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Fasten luminaire to indicated structural supports.

   1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

B. Adjust luminaires that require field adjustment or aiming.

3.2 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
B. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
   1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
   2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
   3. Install base covers, unless otherwise indicated.
   4. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.4 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole, unless otherwise indicated.
   2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.5 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
   1. Verify operation of photoelectric controls.

C. Illumination Tests:
   1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the IESNA testing guide lines.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 265600