PROJECT MANUAL

Albany Waterfront Redevelopment

OWNER:
City of Albany
333 Broadalbin St SW
Albany, OR 97321

DESIGN TEAM:
Walker Macy
111 SW Oak St., ste 200
Portland, OR 97204

Permit Set – December 10, 2021

SECTION 00 0110
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SECTION 01 5639-TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes the protection and trimming of trees that interfere with, or are affected by, execution of the Work, whether temporary or new construction.

B. Related Sections include the following:

1. Division 01 Section "Summary" for limits placed on Contractor's use of the site.
2. Division 01 Section "Temporary Facilities and Controls" for temporary tree protection.
3. Division 31 Section "Site Clearing" for removal limits of trees, shrubs, and other plantings affected by new construction.
4. Division 31 Section "Earth Moving" for building and utility trench excavation, backfilling, compacting, grading requirements, and soil materials placement.
5. Division 32 Section “Soil Preparation” for soil materials and amendments.
6. Division 32 Section "Transplanting" for tree and shrub transplanting.
7. Division 32 Section "Plants" for tree and shrub planting, and tree support systems.

1.2 DEFINITIONS

A. Tree Protection Zone: The area surrounding a tree equal to the diameter of its canopy which is designated to protect the roots and health of the tree.

1.3 SUBMITTALS

A. The following Submittals shall be provided prior to commencement of any work on the project site.
1. Product Data: For each type of product indicated.
2. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names, and addresses of Owner’s Representatives and owners, and other information specified.
3. Certification: Written certification from a qualified arborist stating tree protection measures have been correctly installed prior to commencement of construction, that trees have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
4. Maintenance Recommendations: From a qualified arborist outlining procedures for the care, monitoring and protection of trees during construction and following completion of all work on site.
5. Existing Conditions: Provide documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

a. Use sufficiently detailed photographs or videotape.
b. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.4 QUALITY ASSURANCE

A. Tree Service Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will assign an experienced, qualified arborist to the Project site on a full-time basis during execution of the Work.

B. Arborist Qualifications: An arborist certified by the International Society of Arboriculture or licensed in the jurisdiction where Project is located.

C. Tree Pruning Standards: Comply with ANSI A300, "Trees, Shrubs, and Other Woody Plant Maintenance, Standard Practices," unless more stringent requirements are dictated by the arborist or governing agencies.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before starting tree protection and trimming, meet with representatives of authorities having jurisdiction, Owner, Owner’s Representative, Landscape Architect, consultants, and other concerned entities. Review tree protection and trimming procedures and responsibilities. Notify participants at least three working days before convening conference. Record discussions and agreements and furnish a copy to each participant.

1.5 PROJECT CONDITIONS

A. The following practices are prohibited within tree and shrub protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle or foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Modification of soil grade by cutting or filling unless indicated otherwise.
8. Damage to roots by grading, tearing, or grubbing.
9. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
10. Cleaning equipment or material.

B. Do not direct vehicle or equipment exhaust toward tree protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near tree protection zones.

D. No damaging attachment, wires, signs, or permits may be fastened to any protected tree.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, Size 24, with 90 to 100 percent passing a 2-1/2-inch sieve and not more than 10 percent passing a 3/4-inch sieve.

B. Topsoil: Fertile, friable, surface soil, containing natural loam and complying with ASTM D 5268. Provide topsoil that is free of stones larger than 1 inch in any dimension and free of other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from well-drained sites where soil occurs in depth of 4 inches or more; do not obtain from bogs or marshes.

C. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.

D. Tree Protection Fence: Galvanized chain-link fence of minimum 6ft tall, secured with metal posts driven in the ground with signage designating the tree protection zone attached to the fence every 30 feet.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to commencing work on site, the Contactor shall:
   1. Review the existing site conditions. Any conflicts or discrepancies between existing conditions and the documented grades shall be immediately brought to the attention of the Landscape Architect.
   2. Verify all work can be performed outside of designated tree protection zones, without altering existing grade beneath trees, causing damage to, or removing tree roots. Any work which cannot be performed under these conditions shall be immediately brought to the attention of the Landscape Architect.
      a. For work performed within the encroachment zones as identified on drawings,

B. Protection Zone Fencing: Install fencing as indicated on the documents or outside the drip line of trees, to protect existing vegetation to remain from construction damage.
   1. If installing tree protection is infeasible in any portion of the site due to steep slopes or other conditions, propose an alternative method of identifying the tree protection zone and obtain approval from the Owner’s Representative prior to installation.

C. Protect tree root systems from damage caused by runoff or spillage of noxious materials when mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.

D. Protect all existing plant material to remain against unnecessary cutting, breaking, or skinning of roots and branches, or skinning and bruising of bark.

E. Do not store construction materials, debris, or excavated material within the drip line of remaining trees. Do not permit vehicles or foot traffic within the drip line; prevent soil compaction over root systems.

F. Do not allow fires under or adjacent to remaining trees or other plants.

G. Do not spray any herbicide or toxic substance within drip line of any existing plant material without approval of Owner's Representative.

H. Water trees and other vegetation which are to remain as necessary to maintain their health during the course of the work. Rate of frequency of application to be determined jointly by Arborist and Owner's Representative.

3.2 DEMOLITION WITHIN TREE PROTECTION ZONE

A. Demolition of existing paths and other infrastructure within the TPZ shall proceed with caution. Spoils should be hauled outside of the TPZ immediately (no temporary stockpiles). Coordinate with the Owner's Representative if tree roots are revealed during demolition to document exposed roots and tree protection measures, and provide on-the-ground recommendations, if needed.

3.3 EXCAVATION AROUND TREES

A. Do not excavate within drip line of trees, unless otherwise indicated.

B. Install shoring or other protective support systems to minimize sloping or benching of excavations.

C. When excavating within the tree protection zone, roots smaller than 2" diameter may be pruned clean to sound wood using a sharp saw as digging progresses to avoid pulling and tearing roots. Prune roots at the limits of work perpendicular to the natural growth direction with bark firmly intact.

D. Where trenching is required within drip lines, tunnel under or around roots larger than 2" diameter by hand digging or boring. . Where excavating or tunnelling around roots is not feasible, review conditions with Owner's Representative. Do not cut roots larger than 2" diameter without approval from owner's Representative.

E. Where excavating for new construction is required within drip line of trees, hand excavate to minimize damage to root systems. Use narrow tine spading forks and comb soil to expose roots.

1. Relocate roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and relocate them without breaking. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

F. Where utility trenches are required within drip line of trees, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.

1. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop.

G. Prune branches in accordance with good horticultural practice to balance loss to root system caused by damage or cutting of root system.

H. Where silt fencing is required to be installed within the tree protection zone, it shall not be trenched in. Use straw wattles or compost socks staked above grade to secure silt fence.

3.4 GRADING AND FILLING AROUND TREES

A. Maintain existing grade within drip line of trees unless otherwise indicated. Install protection measures as shown on the Drawings.

B. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade beyond drip line of trees. Maintain existing grades within drip line of trees.

C. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by qualified arborist, unless otherwise indicated.

1. Root Pruning:

Excavation beneath the dripline of protected trees shall be avoided if alternatives are available. Roots smaller than 2-inches in diameter may be pruned clean to sound wood using a sharp saw as digging progresses to avoid pulling and tearing roots; prune roots at the limits of work perpendicular to the natural growth direction with bark firmly intact. Excavation immediately adjacent to roots 2-inches and larger in diameter shall be by hand or other non-invasive techniques to ensure that roots are not damaged. The Contractor shall coordinate with the Project Arborist to assess and document roots 2-inches and larger in diameter prior to impacts. Where feasible, these roots shall be protected by tunneling or other means to avoid destruction or damage. Exceptions can be made if, in the opinion of the Project Arborist, unacceptable damage will not occur to the tree. The Project Arborist shall document any such coordination in a report to the City.

D. Fill: Where new surfacing is proposed within the TPZ, avoid excavation, and use a modified profile to build up from existing grade where feasible. The uppermost organic matter may be gently scraped from the ground using an excavator with a flat blade bucket (no excavation). Place a layer of permeable geotextile fabric on the ground surface and top the fabric with clean crushed rock per the pavement detail to raise the grade as needed. Surfacing may include asphalt, concrete, or other materials.

3.5 TREE REMOVAL

A. Trees to be removed shall be clearly identified with tree-marking paint or other methods approved in advanced by the project arborist. Tree removal shall be performed by a

Qualified Tree Service. Tree protection fencing may be temporarily opened to allow tree removal within the TPZ. Directionally fell trees with caution or surgically remove them from the top down to avoid damage to protected trees.

3.6 STUMP REMOVAL

A. Stumps of trees planned for removal that are located within the RPZ of retained trees shall be removed by stump grinding to just below the ground surface. Stumps of trees planned for removal that are located along steep riverbanks shall be removed with the Owner's Representative and upon approval, shall remain in the ground and be treated with an aquatically safe herbicide, pre-approved for use by the Owner's Representative, applied to the fresh cut stump face using a paint brush on a dry day or as otherwise specified by the manufacturer.

3.7 SNAG CREATION

A. Trees that are identified for snag creation shall be delimbed and reduced in height to 1.5-times the distance to the nearest target (pathways and other infrastructure occupied by park users). Deciduous trees shall also be girdled around 5-feet above ground level to help inhibit sprouting.

3.8 TREE PRUNING

A. Prune remaining trees affected by temporary and new construction as approved by Owner's Representative.
   1. Prune all dead or hazardous branches larger than 2 inches in diameter from all trees to remain.
   2. Prune low branches which overhang walks, roads, drives or parking areas.
      a. Walks – within 8 feet vertically of a walk surface.
      b. Parking – within 12 feet vertically of the parking surface.
      c. Roads and Drives – within 14 feet vertically of the drive surface.

B. Prune remaining trees to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by qualified arborist.

C. Pruning Standards: Prune trees according to ANSI A300 as follows:

   1. Type of Pruning:
      a. Crown cleaning.
      b. Crown thinning.
      c. Crown raising.
      d. Crown reduction.
      e. Vista pruning.
      f. Crown restoration.

D. Cut branches with sharp pruning instruments; do not break or chop.

E. Chip branches removed from trees. Spread chips where indicated on the Drawings or as directed by Owner's Representative.

3.9 IVY REMOVAL

A. Create a life-saver ring around trees that have English ivy growing up the trunk. Use loppers, garden shears, or a pruning saw to carefully cut ivy vines all the way around the circumference of the tree trunk at waist height. Peel the cut vines from the bark downward to the base of the tree, then pull back the ivy from the tree at ground level to create a minimum 5-foot radius ivy-free zone. Be sure to pull ivy roots from the ground. Ivy remaining on the tree above waist height should die if it was completely severed and could be removed once it is dead and dried up.

3.10 PLANTING WITHIN TREE PROTECTION ZONE

A. Tree protection fencing may be removed when landscaping commences within the TPZ. Where landscaping is desired, remove weeds by hand and with hand tools and apply 2- to 3-inches of mulch beneath the dripline of protected trees, but not directly against tree trunks. Seed mix, shrubs, and other ground cover plants may be installed by hand and should be adjusted as needed to avoid tree root impacts. If irrigation is used, ensure that any irrigation spray heads are directed away from tree trunks.

3.11 TREE REPAIR AND REPLACEMENT

A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to written instructions of the qualified arborist. Engage a qualified tree surgeon to advise Contractor on appropriate protection measures and to perform tree repair work if required. Make repairs promptly after damage occurs at no additional cost to the Owner.

B. Remove and replace dead and damaged trees that the qualified arborist determines to be incapable of restoring to a normal growth pattern.

1. Provide new trees of the same size and species as those being replaced; plant and maintain as specified in Division 32 Section "Plants."

C. Provide new trees of 2-inch caliper size and of a species selected by Owner's Representative when trees more than 6 inches in caliper size, measured 12 inches above grade, are required to be replaced.

D. In the event that any trees are damaged, destroyed, or removed as a result of Contractors', its agents', or employees' acts or omissions; then damages shall be assessed against the Contractor in accordance with the trunk formula method set forth in The Council of Tree and Landscape Appraisers "Guide for Plant Appraisal," latest edition. In the event that a tree is damaged, but not to the extent that it must be removed, damages will be calculated as a percentage of the total value of the damaged tree, as estimated by the Owner's Arborist. Contractor shall also pay as damages, all costs associated with the appraisal of

tree damage, lost tree value and any required repairs to the trees as determined solely by the Owner's Arborist.

E. Owner may elect to receive compensation for plants destroyed or damaged by the Contractor. Trees shall be valued at $25,000 each, and shrubs at $1,000 each. The compensation shall be paid by the Contractor for each occurrence of loss due to the Contractor's activities or negligence. The compensation shall be paid by the Contractor for each occurrence of loss due to the Contractor's activities or negligence.

F. Any wound or damage by construction activities to an existing tree indicated to remain constitutes partial injury. These include, but are not limited to:
   1. Any tissue damage.
   2. Unauthorized cutting, breaking, or removing tree branches or roots.
   3. Unauthorized ingress, cutting or damaging protected root zones.
   4. Soil compaction.
   5. Toxic run-off into tree preservation areas.
   6. Unauthorized discharge of materials into the tree protection zone.

G. Partial injury will be calculated by percentage, estimated by the Owner's Representative Owner's Arborist, of the total value of the damaged tree. Damages for partial injuries will include the cost to the Owner for loss appraisal by the Owner's Representative's and Owner's Arborist's plus the cost for necessary damage repair.

H. Aerate surface soil, compacted during construction, 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch diameter holes a minimum of 12 inches deep at 24 inches on center. Backfill holes with a mix of equal quantities of augered soil and sand.

3.12 DISPOSAL OF WASTE MATERIALS

A. Burning is not permitted.

B. Disposal: Remove excess excavated material, displaced trees, and excess chips from Owner's property.

END OF SECTION 01 5639

SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building demolition excluding removal of hazardous materials and toxic substances.

1.02 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction Current Edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2019.

1.03 SUBMITTALS

A. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
   1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
   2. Identify demolition firm and submit qualifications.

1.04 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of 5 years of documented experience.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 SCOPE

A. Remove the entire building bandstand.

B. Remove concrete slabs on grade at bandstand and surrounding area.

C. Remove fences and gates.

D. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

E. Remove all remaining furniture.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   5. Provide, erect, and maintain temporary barriers and security devices.
   6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   8. Do not close or obstruct roadways or sidewalks without permit.
   9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
   10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

E. If hazardous materials are discovered during removal operations, stop work and notify Design Team and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

F. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Dismantle existing construction and separate materials.
   2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.03 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE 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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, finishes.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

C. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

D. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Reference General Structural Notes for mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: For fabrication and installation.

1. Requirements:
   a. Provide details of fabrication, bending, and placement, prepared according to ACI SP-66 “ACI Detailing Manual.” Include special reinforcement required for openings through concrete structures.

b. Shop Drawings shall contain sufficient detail and information to allow complete fabrication, bending, and placement of steel reinforcement without reference to the contract drawings either on the fabrication shop floor or at the project site.

c. The detailer shall generate all shop drawings including fabrication and installation details from the structural and architectural drawings and specifications. The use of reproductions or photocopies of the contract drawings are not permitted. When CAD or REVIT files are provided, it is the responsibility of the detailers to remove all information not directly relevant to the creation of the placing drawings as well as all references to the outside sources of the files.

d. Re-submittals shall clearly identify all revisions to previous submittals.

1) Heavy ink clouded outlines (revision clouds) shall be drawn around revised areas of individual sheets.

2) Architect/Engineer will not review information outside of revision clouds on resubmitted drawings.

2. Include plans for all slabs and elevations for all concrete beams, walls, and columns to show bar arrangement. Plans and elevations to include special reinforcement required for openings through concrete structures.

3. Show bar arrangement identifying size, shape, grade, and location of steel reinforcement. Include bar material, grade, sizes, lengths, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical and welded connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Formwork Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.

2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

a. Locations of all exposed joint types are subject to approval of the Architect.

3. Indicate chamfers, reveals and rustification strips.

4. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

E. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.

2. Ready-mixed concrete manufacturer.

3. Testing agency: Include copies of applicable ACI certificates.

F. Welding certificates.

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

1. Cementitious materials.

2. Admixtures.

3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Bonding agents.
7. Adhesives.
8. Joint-filler strips.
9. Repair materials.

H. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

I. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

J. Field quality-control reports.

K. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Ready-Mix Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 117.

2.3 FORM-FACING MATERIALS

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

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    a. APA HDO (high-density overlay), Class I or better.
    b. APA MDO (medium-density overlay) Class I or better.; mill-release agent treated and edge sealed.
    c. APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
    d. APA Plyform Class I, B-B or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.4 STEEL REINFORCEMENT AND ACCESSORIES

A. Reinforcing Bars: Types indicated on Drawings.

B. Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

C. Steel Tie Wire: Plain finished, ASTM A1064, annealed steel, not less than 0.0508 inch in diameter.

D. 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, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

1. Use CRSI Class 1 plastic-protected steel wire, CRSI Class 2 stainless-steel bar supports or precast dobies.

2.5 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150, Type I/II gray.
2. Fly Ash: ASTM C618, Class F or C.
3. Slag Cement: ASTM C989, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33.

1. Maximum Coarse-Aggregate Size: As indicated.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494, Type A.
2. Retarding Admixture: ASTM C494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494, Type C.

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

        1) BASF Corp. - Construction Chemicals.
        2) Euclid Chemical Company (The); an RPM company.
        3) GCP Applied Technologies Inc. (formerly Grace Construction Products).
        4) Sika Corporation.

8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

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

        1) BASF Corp. - Construction Chemicals.
        2) Euclid Chemical Company (The); an RPM company.
        3) GCP Applied Technologies Inc. (formerly Grace Construction Products).
        4) Sika Corporation.

F. Water: ASTM C94 and potable and ASTM C1602.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

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

    a. BASF Corp. - Construction Chemicals.
    b. ChemMasters, Inc.
    c. Dayton Superior.
    d. Euclid Chemical Company (The); an RPM company.
    e. L&M Construction Chemicals, Inc.
    f. W.R. Meadows, Inc.

2.7 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109.

C. Vertical and Overhead Surface Repairs: Cement-based, polymer modified product, identified by the manufacturer for use in vertical or overhead applications, that can be applied in thicknesses from 1/8 inch to match adjacent surfaces. For permanently exposed conditions, provide color sample to architect for review prior to application.

1. Cement Binder: ASTM C150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
2. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand.
3. Compressive Strength: Not less than 5,000 psi at 28 days when tested according to ASTM C109.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Reference the General Structural Notes for compressive strength, maximum W/C ratio, and air content.

B. Cementitious Materials: Refer to General Structural Notes.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

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

1. Use admixtures indicated on Drawings, and as required for placement and workability
   a. Use water-reducing admixture in concrete, for placement and workability.
2. Use high-range water-reducing admixture in concrete, as required, for placement and workability.

3. Use-retarding admixture and water reducing when required by high temperatures, low humidity, or other adverse placement conditions.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.9 FABRICATING REINFORCEMENT

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

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94 and ASTM C1116, 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 EXAMINATION

A. Verification of Conditions:

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

2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 FORMWORK INSTALLATION

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

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 and ACI 117 as abrupt or gradual, as follows:

1. Class A, Surface Finish-3.0: 1/8 inch
2. Class B, Surface Finish-2.0: 1/4 inch.
3. Class C: 1/2 inch.
4. Class D, Surface Finish-1.0: 1 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, dovetail slots, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

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

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.3 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Clean embedded items immediately prior to concrete placement.

B. Penetrating Items: Expansion joint material at penetrations.

1. Place expansion joint material where indicated. Refer to “Isolation Joints” in “Joints” Article below.
2. All plumbing piping, HVAC and sewerage piping penetrating concrete slabs and shall have expansion joint material at interface with concrete. No piping shall be embedded in concrete without expansion joint material.

3.4 REMOVING AND REUSING FORMS

A. Refer to General Structural Notes for removal time.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 STEEL REINFORCEMENT INSTALLATION

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

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

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

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

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

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 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 Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete and complying with cover requirements indicated.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans and at approved locations where exposed. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth as indicated.

1. 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 does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
2. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
2. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
3. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 07 92 00 "Joint Sealants," are indicated.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

A. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

2. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
3. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

C. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

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

3.8 FINISHING FORMED SURFACES

A. As-Cast Concrete Finishes: As-cast concrete texture imparted by form-facing material, as follows:

1. Rough-Formed Finish: ACI 301 Surface Finish SF-1.0.

    a. Finish: As-cast. Tie holes patched.
    b. Remove fins and other projections larger than 1-inch that exceed specified limits on formed-surface irregularities.
    c. Surface Tolerance: ACI 117, Class C or D.
    d. Application: Apply to concrete surfaces not exposed to public view.

2. Smooth-Formed Finish: ACI 301 Surface Finish SF-2.0 and SF-3.0.

    a. Finish: Panel joints and tie-hole arranged in an orderly and symmetrical manner with a minimum seams. Minimize surface imperfections.
    b. Repair and patch tie holes and defects with materials and methods approved by Architect.
    c. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
    d. Surface Tolerance by Application:

        1) ACI 117 Class A: Where exposed to public view.
        2) ACI 117 Class B:
            a) Where exposed but back-of-house spaces

b) At other finishes are scheduled or covering directly placed on concrete.

B. Rubbed Finishes: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish:

a. Perform no later than one day after form removal.
b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.

2. Grout-Cleaned Rubbed Finish:

a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
b. Do not clean concrete surfaces as Work progresses.
c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
d. Wet concrete surfaces.
e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.

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

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Finish and measure slab surfaces so gap at any point between concrete surface and an unlevelled, freestanding, 10ft long straight edge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch.

C. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
3. Apply scratch finish to surfaces indicated.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, stage floor, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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

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

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
   1. Comply with ACI 301 and ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
   2. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.

B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. 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 with the following materials:

      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

      a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
a. Absorptive cover.
b. Moisture-retaining-cover
c. Ponding or continuous sprinkling of water.

3.12 TOLERANCES

A. Conform to ACI 117.

3.13 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than 28 days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least [one] [six] month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
3. Prior to repairing defective areas, Contractor shall provide mockup for Architect’s review of materials and methods for matching.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval and Structural Engineer of Record’s review, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

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

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and to submit reports.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231, pressure method, for normal-weight concrete;one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31.

   a. Cast and laboratory cure four standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39; test one laboratory-cured specimen at 7 days and three specimens at 28 days.

   a. Test one field-cured specimens at 7 days and three specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of three specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 03 30 00

SECTION 03 3053 –SITE CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies cast-in place concrete for the site, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following exterior applications of concrete:

1. Footings.
2. Raised concrete light pole tootings

3. Concrete stairs.
4. Concrete retaining walls.
5. Seat walls.
6. Planter walls.
7. Cheek walls.

B. Related Sections include the following:

1. Division 31 Section “Earth Moving” for subgrade preparation, grading, base course, and subbase course.
2. Division 31 Section “Earth Moving” for drainage aggregate.
3. Division 32 Section " Concrete Paving" for concrete pavement.
4. Division 32 Section “Unit Paving” for pavers on concrete bases.

C. Concrete forms, mixing, placing, and curing shall conform to ACI Manual of concrete practice and its specifications.

D. Concrete testing:

1. Notify Owner’s Representative to coordinate concrete compressive cylinder tests. Three sets of tests are required for each 100 cubic yards; conform to ASTM Specifications. Test 1 at 7 days and 2 at 28 days. Concrete cylinders to be provided by Contractor. Cost of testing by Owner.
2. Failure of strength tests:

    a. In the event the concrete compressive cylinder strengths fall below that permitted, the Owner’s Representative may require hardened concrete core tests, load testing, additional structural computations and any other remedial measures required with all cost paid by the Contractor.
    b. If remedial measures are not acceptable, the Contractor is responsible for the costs of removing the defective work and replacing it to the Owner’s Representative's satisfaction at no additional cost to the Owner.

1.2 SUBMITTALS

A. Test reports: Submit copies to Owner's Representative.

B. Product Data: For each manufactured material and product indicated.

C. Design Mixes: For each concrete mix indicated.

D. Shop Drawings: Include details of steel reinforcement placement including material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports.

E. Material Test Reports.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Placement during rain or adverse conditions shall not be permitted. Surface temperature must be 45 degrees Fahrenheit and air temperature rising.

B. Place no concrete when temperature is below 45 degrees Fahrenheit, without written approval of the Owner's Representative. Contractor assumes full responsibility, including costs for retesting concrete. Concrete damaged by freezing shall be removed and replaced at Contractor's expense, at no additional cost to the Owner.

C. Placement of concrete in excessively hot weather, windy or dry conditions shall be in accordance with requirements of ACI-605.

D. Remove and replace defective work as directed by the Owner's Representative, at no additional cost to the Owner.

1.4 PROTECTION

A. Protect surrounding areas, surfaces, work, trees, and shrubs to preclude damage, excessive compaction of adjacent soil and intrusion of materials into soil during execution.

B. Protect base rock from intrusion of foreign materials. Protect finished concrete paving from traffic and vandalism to provide adequate curing time.

1.5 TRAFFIC CONTROL AND TEMPORARY ACCESS

A. Provide barricades, cones and signs required for driveway closures and detours. See Division 01 Section "Temporary Facilities and Controls" for additional requirements.

1.6 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.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

D. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specification for Structural Concrete," including the following sections, unless modified by requirements in the Contract Documents:
      a. "General Requirements."
      b. "Formwork and Formwork Accessories."
      c. "Reinforcement and Reinforcement Supports."
      d. "Concrete Mixtures."
      e. "Handling, Placing, and Constructing."
   2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."
   3. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
   4. ACI 347R: Guide to Formwork for Concrete.

F. Installer Qualifications: A company engaged for a minimum of five consecutive years in the placement and finishing of architectural concrete, integrally colored concrete, concrete colored using dry-shake hardeners, color stained concrete and the application of specialty finishes including skin embossing and stamping.

   1. Provide a minimum of three references for completed projects of similar size and design to the work of this section. Reference shall include owner’s name, contact information and approximate construction cost of the project.
   2. Provide a minimum of five photographs, 8”x10” size, of each of the referenced projects indicating representative placement, jointing and scoring, colors and finishes.
   3. Concrete finishing crews shall include at least three (3) individuals ACI certified for flatwork.

G. Formwork Observation: Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Notify Owner’s Representative 24 hours minimum prior to placing concrete that formwork is in place and ready for observation. Do not proceed with concrete placement prior to obtaining Owner Representative’s approval that formwork meets the lines and grades intended on the Drawings. Concrete placed without the Owner Representative’s approval of formwork shall be removed and replaced when directed by the Owner’s Representative, at no additional cost to the Owner.

1.7 FIELD SAMPLE PANELS:

A. Before casting architectural concrete, produce field sample panels. Produce a full-scale panel, cast vertically, at a minimum size of 36 by 36 by 6 inch thickness to demonstrate the expected range of finish, surface etching, color, and texture variations. All costs associated with the construction of Field Sample Panels to obtain Owner's Representative's approval shall be at the Contractor's expense.

1. Provide sample panel for:
   a. Smooth form finish concrete
2. Locate panels as indicated or, if not indicated, as directed by Owner's Representative.
3. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.
4. In presence of Owner's Representative, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
5. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove field sample panels when directed.

PART 2 - PRODUCTS

2.1 FORMWORK

A. Furnish formwork and formwork accessories according to ACI 301.

B. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Provide appropriate form liner material to shape the reveal patterns indicated on the Drawings.

C. Form-Facing Panels for As-Cast Finishes: Exterior-grade plywood panels, nonabsorptive, that will provide continuous, true, and smooth architectural concrete surfaces, high-density overlay, Class 1, or better, complying with DOC PS 1.

1. Product with successful previous use:
   a. Olympic Panel Products "Classic HDO Concrete Form" resulting in semi-gloss concrete surface.
   b. Finnish phenolic overlaid birch plywood.

2. Steel, glass-fiber-reinforced plastic, or other approved non-absorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces may be used
3. Furnish in largest practicable sizes to minimize number of joints. Use 4 foot by 8 foot sheets at all locations exposed to view, unless otherwise noted.

D. Corner Formers: Metal, rigid plastic or elastomeric rubber; radius as indicated; nonstaining; in longest practicable lengths.

E. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch thick.

F. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, which adheres to form joint substrates.

G. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

H. Form Ties: Factory-fabricated, internally disconnecting ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal. Form Ties shall be manufactured specifically for use as concrete ties and shall be designed to seal tightly to the form face material without fluid loss and to prevent spalling of concrete on removal.

1. Glass-fiber-reinforced plastic ties, not less than 1/2 inch in diameter, of color selected by Owner's Representative from manufacturer's full range may be used.

I. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Where surface retarded finish is specified, form release agent to be compatible with surface retarder.

2.2 STEEL REINFORCEMENT

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

B. Plain-Steel Wire: ASTM A 82, as-drawn.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, AASHTO M55, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

E. Dowel Bars: ASTM A 615, Grade 60, non-deformed.

F. Epoxy-Coated Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, ASTM A 775 epoxy coated.

2.3 STRUCTURAL STEEL AND MISCELLANEOUS IRON

A. Structural steel shall conform to ASTM A-36.

B. Anchor bolts shall conform to ASTM A-307, Grade A. Galvanize all embedded items.

2.4 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 II or I/II. Supplement with the following:

    a. Fly Ash: ASTM C 618, Class C or F.
    b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Portland Cement Concrete shall develop minimum 28 day laboratory cured compressive cylinder strength of 4000 PSI, min. 6 sacks of cement per cubic yard.

C. Nominal maximum size of coarse aggregate in first paragraph below is common. (Revise to smaller size for example where an exposed aggregate (heavy sandblast) finish is desired. Note however, that a smaller aggregate size may increase the design mix to 6 sacks of cement per cu-yd. Verify with Ready-Mix manufacturer.) ACI 301 sets maximum sizes based on spacing of reinforcement, dimensions between sides of forms, and thicknesses of slabs.

D. Normal-Weight Aggregate: ASTM C 33, graded. Provide aggregates from a single source with documented service record data of at least 10 years satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Meet requirements of Section 9-03.1 “Aggregates for Portland Cement Concrete” of the "Standard Specifications for Road, Bridge, and Municipal Construction" as prepared by the Washington State Department of Transportation, latest edition.

1. Maximum Coarse Aggregate Size: 1inch.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

E. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.6 RELATED MATERIALS

A. Vapor Retarder: Multi-ply reinforced polyethylene sheet, ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

B. Expansion Joint Filler Strips: ASTM D 3575, closed-cell polyethylene foam backing, with removable joint cap, for joints wider than 1/4-inch.

C. Joint Primer: ASTM C 920, solvent based primer for preparing concrete surfaces for adhesion to sealant. Provide product recommended for use by joint sealant manufacturer.

D. Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, high-movement, nonsag, fast curing, silyl-terminated polyether sealant. Color to be selected by Owner's Representative.

E. Where sealant is to be applied to porous materials subject to intermittent water immersion, prime joints with MasterSeal P179, or equal.

F. Backer Rod: Non-gassing, reticulated closed-cell polyethylene rod designed for use with cold-applied joint sealants where joint depth exceeds manufacturer's recommended depth for joint sealant. Comply with ASTM C 1330, Type C. Size as required for joint design.

G. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775.

H. Drainage Mat: Impermeable polypropylene sheet with dimpled drainage core and bonded layer of nonwoven filter fabric. J-Drain 400 Series, by JDR Enterprises, Inc. or approved equal.

2.7 SURFACE RETARDANT AGENT:: A surface applied retarder for producing an etched finish on freshly placed concrete.

A. Product: "Top-Cast" concrete surface retarder, by GCP (www.gcpat.com)
   1. Acceptable alternate product "Pieri" by GCP may be used for formed surfaces.
   2. Provide the following grades for application to the Field Sample Panels for review and final selection of a preferred level of finish to be applied to the site mockup and use on the project.
      a. Architectural Concrete Type 1: Light Violet, Grade 03, Powder Blue Violet, Grade 05, Yellow, Grade 15

2.8 CURING MATERIALS

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

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

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

D. Water: Potable.

E. Curing and Sealing Compound: Clear, Waterborne, Membrane-Forming, ASTM C 309, Type 1, Class A and B; AASHTO M-148. 'Sonneborn' Kure-n-Seal WB or equal.

2.9 CONCRETE MIXTURES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, as follows:

1. Minimum Compressive Strength: 4000 psiat 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45
3. Slump Limit: 5-1/2 inches .
   a. 7-1/2 inches is acceptable for concrete with verified slump of 5-1/2inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1/2 inch.
4. Air Content: Maintain within range permitted by ACI 301. Where required for exposed surfaces, add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 4.5 to 7.5 percent within a tolerance of plus 1.0 or minus 1.5 percent.

2.10 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 above 90 degrees Fahrenheit, reduce mixing and delivery time to 60 minutes.

B. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit on site.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine subgrade scheduled to receive concrete for conditions that will adversely affect the execution, quality, and performance of Work. Do not start Work until unsatisfactory conditions have been corrected to the satisfaction of the Owner's Representative.

3.2 SUBGRADE

A. The subgrade within the limits of trenches constructed under this Contract shall be constructed in accordance with Division 31 Section “Earth Moving” and as modified in this Section. Compact the subgrade to 95 percent of the maximum density by ASTM D1557. Accomplish supplementary compaction where required with approved mechanical vibrating or power tampers. Notify Owner’s Representative to allow for subgrade density tests before placing base aggregate.

3.3 CRUSHED AGGREGATE

A. Crushed aggregate base course shall be placed under all pavement to be constructed or replaced. Place base course rock on the previously conditioned, compacted, and tested subgrade to the specified thickness as shown on the Drawings.

B. Compact aggregate base course to 95 percent of the maximum as determined by ASTM D1557. Notify Owner’s Representative to allow for density tests before placing crushed aggregate base course.

3.4 FORMWORK

A. Design, construct, erect, brace, and maintain formwork according to ACI 301 and ACI 347R for Class A formwork

B. Install forms to line and grade required.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood keyways, reglets, recesses, and the like, for easy removal.

1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
2. Do not use rust-stained steel form-facing material.

D. Provide double layer of formwork to avoid having nail holes visible on the finished concrete. Nail backing layer to supports and back screw concrete facing layer to backing layer. Nail backing layer of plywood along edges, and to intermediate supports, with common wire nails spaced as necessary to maintain alignment and prevent warping.

E. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

F. Corners: Seal all corners. When building the form panels for the corners, make all cuts with table saw. Radius, do not chamfer exterior corners and edges of cast-in-place architectural concrete.

G. Coat contact surfaces of absorptive corner formers with sealer before placing reinforcement, anchoring devices, and embedded items.

H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

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

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

L. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

M. Notify the Owner’s Representative at least 24 hours before an intended pour. Place no concrete until forms have been reviewed and approved by the Owner’s Representative.

3.5 REINFORCING STEEL

A. See Drawings for reinforcing of footings, walls, slabs, and location of dowelled joints.

B. All reinforcing steel shall be detailed, fabricated and placed in accordance with ACI Detailing Manual 315.

1. All reinforcing steel shall be accurately and securely placed.
2. Reinforcing shall not be bent or displaced for the convenience of other trades unless approved by the structural engineer or Owner’s Representative.
3. Splay reinforcing steel around openings with 1 inch in 10 inches splay unless otherwise shown in the Drawings.
4. Minimum cover from concrete surfaces to reinforcing steel shall be:
    a. 3 inches + 1/2 inch to bottom of footing
    b. 1 1/2 inches + 1/4 inch to earth face of wall
    c. 1 inch + 1/4 inch to exposed face of wall

5. Lap all bars a minimum of 36 bar diameters except as noted otherwise on Drawings.

3.6 JOINTS

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

1. Unless shown on the Drawings, a jointing and placement plan shall be prepared by the Contractor and approved before concrete placement begins.
2. When approved by the Owner's Representative, make minor adjustments in joint location to make them coincide with drainage structures or other appurtenances.
3. Contraction Joints in site concrete walls shall be spaced at maximum 20-foot intervals with isolation joints at maximum 80-foot intervals or as shown on the Drawings. Isolation joints shall be struck vertically and full depth. Align joints in concrete walls with joints in finish paving.

B. Construction Joints: Locate and install so strength and appearance of concrete are not impaired, at locations indicated on the Drawings, or as approved by Owner’s Representative.

1. Construction joints shall be keyed at bottom of form.

3.7 CONCRETE PLACEMENT

A. Comply with ACI 301 for measuring, batching, mixing, transporting, and placing concrete.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

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

D. Consolidate concrete with mechanical vibrating equipment.

E. Cold-Weather Placement: Comply with ACI 306.1

F. Hot-Weather Placement: Comply with ACI 305.1

G. Stripping of forms shall not be performed until concrete has set sufficiently to retain its true shape.

H. Prior to backfilling, place drainage mat securely against vertical wall faces as indicated on drawings.

3.8 FINISHING FORMED SURFACES

A. SITE WALLS, RETAINING WALLS, SEAT WALLS, CHEEK WALLS AND RAISED CONCRETE LIGHT POLE FOOTINGS:
1. Surface retarded exposed aggregate finish
a. After final floating, apply a hand-trowel finish to exposed surfaces.

b. Remove form work when concrete will retain its form.
c. Prior to removal of retarder on entire concrete surface, test removal on a small area to determine if aggregate will remain in place without being loosened or dislodged during removal procedures. Finish surface shall match the Architect's approved mockup.
d. Provide a 1/4" radius on tops and edges of formed surfaces unless indicated otherwise.
e. Apply Chemical Surface Retarder uniformly over the surface of fresh concrete. Follow manufacturer recommendations for application and removal of retarder product.
f. Remove the retarded surface by use of a pressure washer or water from a hose, do not over finish. Pressure washing will facilitate removal, especially in larger areas. Control runoff in accordance with local, state, and federal regulations.

2.

B.

1.

C. Nonslip Broom Finish: Apply a nonslip broom finish to surfaces indicated and to exterior surface of concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Provide sample panel; do not proceed with Work until finish is approved by Owner's Representative.

3.9 WARNING STRIPPING AT STAIR TREADS and LANDINGS

A. Form grooved nosing in stair treads where indicated on Drawings.

3.10 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures and mechanical injury after placement. Comply with ACI 306.1 for cold-weather protection and with ACI 305R for hot-weather protection during curing.

B. 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.

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

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
   a. Water.

b. Continuous water-fog spray.
c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

E. When concrete is being placed in cold weather and the temperature may drop below 35 degrees Fahrenheit, straw, hay, insulated curing blankets, or other suitable material shall be provided along the line of work to prevent freezing of concrete. Concrete injured by frost action shall be removed and replaced at the Contractor's expense.

F. Take precautions to protect concrete from vandalism during curing. Replace all damaged or vandalized areas to the satisfaction of the Owner’s Representative at no additional cost to Owner. Replace concrete starting at transition joints only.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to, perform tests, and submit test reports during concrete placement according to requirements specified in this Article. Provide material samples for Owner’s testing as described below:

B. Tests: According to ACI 301.

1. Testing Frequency: One composite sample shall be obtained for each day's pour of each concrete mix exceeding 5 cubic yard but less than 25 cubic yards, plus one set for each additional 50 cubic yard or fraction thereof.

3.12 CLEANUP

A. Clean all excess concrete, other materials, and debris on a weekly basis and remove from the project site and disposed of in a lawful manner.

END OF SECTION 03 3053

SECTION 04 4100 – DRY PLACED STONE

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes dry round stone field boulders on graded base.

B. Related Sections include the following:

1. Division 31 Section “Earth Moving” for subgrade preparation and grading,.

1.2 SUBMITTALS

A. Source: Provide name and address of stone supplier.

B. Photos: Provide a minimum of three (3) photos of each type and size of specified

C. Samples for Verification: Three (3) of each color and texture of stone.
1. Deliver samples to project site for review.
2. Note: At Owner’s discretion, Owner’s Representative may elect to visit stone supply source and select stones to be purchased for the project.

D. Qualification Data: For Installer.

1.3 MOCK UP

A. Mock up a group of five (5) boulders of varying sizes on site to represent placement and embedment in grade and obtain approval from Owner’s Representative prior to proceeding.
1. Approved mock up may be incorporated into final construction.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store and handle stone to prevent deterioration or damage due to moisture, temperature changes, contaminants, breaking, chipping, or other causes.

PART 2 PRODUCTS

2.1 STONE

A. Field Boulders:

1. Provide round, smooth river boulders, free of cracks, seams or imperfections which would impair the structural integrity of the material.
2. Size: As shown on drawings
3. Source: Pacific Stonescape, Inc. 541-928-7678. Or approved equal.

2.2 INSTALLATION MATERIALS

A. Leveling Base: Comply with requirements in Division 31 Section “Earth Moving” for base material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for excavation tolerances, condition of subgrades, and other conditions affecting performance of stone.

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

3.2 STONE PLACEMENT

A. Layout: Layout boulder locations on site using chalk outlines and obtain approval from Owner’s Representative prior to installation.

B. Place boulders to create natural appearance setting stones so that shortest dimension is vertical.

C. Excavate and place boulders within grade, burying approximately 1/3 to 1/2 of stone and compact soil so that boulders cannot rock or shift under human force.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Comply with requirements in Division 31 Section “Earth Moving” for in-place compaction testing.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

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. Structural steel.

2. Grout.

1.3 DEFINITIONS

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

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

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

1.5 SUBMITTALS

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

B. Shop Drawings: Show fabrication of structural steel.
1. Requirements:
    a. The steel detailer shall generate all Shop Drawing fabrication and installation details from the Contract Documents, including both Structural and Architectural Drawings (collectively referred to as Drawings) and the Specifications.
    b. The use of, reproductions or photocopies of the Drawings is not permitted.
    c. Shop Drawings shall contain sufficient detail and information for complete fabrication and erection without reference to the Drawings either in fabrication or in erection on-site.

d. Where CAD, REVIT or other digital files are provided, it is the responsibility of the detailer to remove all information not directly relevant to the creation of Shop Drawings including the removal all references to files sources.
e. Resubmittals: Clearly identify all revisions to previous submittals.
1) Draw clouded outlines (revision clouds) around revised items or areas of individual sheets.
2) Information outside of revision clouds will not be reviewed.

2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
3. Include embedment drawings.
4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
5. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
7. Identify members not to be shop primed.
8. Show orientation of hollow structural steel members that are exposed to view for locating seams.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs):

1. Provide in accordance with AWS D1.1 for each welded joint qualified by testing, including the following:

a. Power source (constant current or constant voltage).
b. For heavy sections, applicable manufacturer's certifications that the filler metal meets the supplemental notch toughness requirements, as applicable.

D. Delegated-Design Submittal: For structural steel elements and connections indicated on Drawings as delegated, or deferred, include analysis data signed and sealed a qualified Professional Engineer, as defined in "Quality Assurance" Article responsible for their preparation.

E. Design Calculations: Submit design calculations, signed and sealed by a qualified Professional Engineer as defined in "Quality Assurance" Article, employed by the Contractor, for the following:

1. Connections that differ from that indicated in the contract documents.
2. Requests for substitution of member sizes or material grades.
3. Modification of the strength or configuration of structural framing for the convenience to accommodate the erection sequence, construction equipment, and/or material availability.

F. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. If requested, include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

G. Welding Certificates.

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

I. Mill test reports for structural steel materials, including chemical and physical properties.

J. Product Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Grout.

K. Source quality-control test reports.

L. Field quality-control test reports.

M. Survey of existing conditions

N. Surveys: Submit certified copies of each survey conducted by a registered land surveyor, showing elevations and locations of base plates and anchor bolts to receive structural steel, and final elevations and locations for major members. Indicate discrepancies between actual installation and Contract Documents.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: The installer shall have at least five years' experience in similar type and size of project.

B. Shop-Painting Applicators: Qualified in accordance with AISC's Sophisticated Paint Endorsement P2 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1 Retain inspection below only for Projects where AISC Seismic Provisions apply.

D. Inspection and Nondestructive Testing Personnel: Visual welding inspection, and NDT (including ultrasonic testing technicians) shall be conducted by personnel qualified in accordance with AWS D1.8.

E. Professional Engineer Qualifications: A structural engineer who is licensed in the Project jurisdiction (State) and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel similar in material, design, and extent to those indicated for the Project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.

2. Clean and relubricate bolts and nuts that become dry or rusty before use.

3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with provisions of the following specifications and documents using the edition referenced in the applicable building code or current edition where no edition is referenced:

1. AISC 303 "Code of Standard Practice for Steel Buildings and Bridges"
2. AISC 341 "Seismic Provisions for Structural Steel Buildings"
3. AISC 360 "Specification for Structural Steel Buildings”
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

2.2 STRUCTURAL-STEEL MATERIALS

A. Structural Steel Shapes and Bars: Refer to the General Structural Notes.

B. Weathering (Corrosion-Resisting) Structural Steel:

1. Shapes and Plates: ASTM A588, Grade 50.
2. Hollow Structural Sections: ASTM A847 structural tubing.

C. Welding Electrodes: Comply with AWS requirements and as indicated on Drawings.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 and A490 Bolts, Nuts, and Washers: ASTM F3125, Grade A325 and A490 respectively, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; with plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 325-1/ Type 490-1 respectively, compressible-washer type with plain finish.

B. Weathering (Corrosion-Resisting), High-Strength A325 and A490 Bolts, Nuts, and Washers: ASTM F3125, Grade A325 and A490 respectively, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and ASTM F436, Type 3, hardened carbon-steel washers; with plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 325-3/ 490-3 respectively, compressible-washer type with plain finish.

C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.
2. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.

D. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

E. Threaded Shear Stud Connectors: ASTM A29, grades 1010 through 1020, fully threaded externally.

2.4 RODS

A. Headed Anchor Rods: ASTM F1554, Grade 105, straight.
1. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
4. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for exterior and interior applications and a 30-minute working time.

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

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A6 and maintain markings until structural steel framing has been erected.

4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
6. Sandblast all exposed surfaces of weathering steel. Sandblasting shall be performed in accordance with SSPC-SP6 “Commercial Blast Cleaning” SSPC’s Steel Structures Painting Manual. The appearance of the blast cleaned surface shall approximate Pictorial Standard Sa 2 of SSPC-VIS 1, “Pictorial Surface Preparation Standards for Painting Steel Surfaces” except no mill scale particles shall be allowed; only rust or mill scale stains down in the profile will be allowed. The use of acids to remove scale and stains in the field will not be permitted.

    a. Exposed surfaces of steel contaminated with stains, oil, or foreign material after the above sand blasting cleaning process shall be promptly cleaned as directed by the Owner to preserve conditions for uniform weathering of steel.

7. Store weathering steel in a location which will prevent uneven weathering. Store on blocking to prevent contact with ground.

B. Re-Entrant Corners: Provide 1/2-inch radius at all re-entrant corners, unless noted otherwise.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

D. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2.

G. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer’s written instructions.

H. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not enlarge holes by burning. Thermal cutting of holes is permitted with a surface roughness profile not exceeding 1,000 micro-inches as defined in ASME B46.1.
2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High Strength Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

2. Continuously seal joined members exposed to weather by continuous welds.

C. Erection Connections: Place holes, plates, or other attachments required by the Erector so as not to interfere with or cause any other detrimental effect to structural members or their connections.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.

2. Weep holes shall be provided at exterior closed sections where moisture may accumulate. Sizes shall be in accordance with ASTM A123.

3. Materials for galvanizing shall be geometrically suitable for galvanizing as specified in ASTM A384 and A385. For built-up members, assemblies shall be fabricated as required to limit warping and distortion.

B. Bolts, nuts and washers, and iron and steel hardware components shall be galvanized by the hot-dip process in accordance with ASTM A153.

C. Surface Preparation: Steel shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter: Clean steel in accordance with Steel Structures Painting Council (SSPC) SSPC-SP-6, “Commercial Blast Cleaning.”

D. Coating Requirements:

1. Weight: The weight of the galvanized coating shall conform to Table 2 of ASTM A123 or Table 1 of ASTM A153, as appropriate.

2. Surface Finish: The galvanized coating shall be continuous, adherent, as smooth and evenly distributed as possible, and free from any defect that is detrimental to the stated end use of the coated article.
   a. Determine the integrity of the coating by visual inspection and coating thickness measurements.
   b. Where slip factors are required for slip-critical connections, these shall be obtained after galvanizing by suitable treatment of the faying surfaces in accordance with the latest edition of the Specification for Structural Joints Using ASTM A325 or A490 bolts as approved by the Research Council on Structural Connections of the Engineering Foundation.

3. Adhesion: The galvanized coating shall be sufficiently adherent to withstand normal handling during transport and erection.

E. Touch-Up and Repair

1. Mechanical Damage: Repair areas damaged by welding; flame cutting; or during handling, transport, or erection in accordance with ASTM A780 by one of the following methods:

a. Cold Galvanizing Compound (zinc-rich paint): Per Part 2, "Primer" Article, in accordance with ASTM A780, Annex A2.

1) Spray- or brush-apply the touch-up paint in multiple coats to a dry film that matches the hot-dip galvanizing thickness. Provide minimum thickness of at least 6 mils (4 mils for material less than 1/4-inch thick). Apply a finish coat of aluminum paint to provide a color blend with the surrounding galvanizing.
2) Verify coating thickness by measurements with a magnetic or electromagnetic gauge.

b. Zinc-Based Solder: In accordance with ASTM A780, Annex A1.

1) Apply the zinc-based solder that matches the hot-dip galvanizing thickness. Provide a minimum thickness of 4 mils (3 mils for material less than 1/4-inch thick).
2) Verify coating thickness by measurements with a magnetic or electromagnetic gauge.

2. Wet Storage Stain:

a. Remove any wet storage stain if formed and discovered prior to leaving the galvanizer's plant unless late pick up or acceptance of delivery has necessitated the material being stored in unfavorable conditions. Remove wet storage stain before installation so that premature failure of the coating will not occur. Remove wet storage stain as follows:

1) Arrange the object so that their surfaces dry rapidly.
2) Remove light deposits by means of a stiff bristle (not wire) brush. Heavier deposits are to be removed by brushing with a 5 percent solution of sodium or potassium dichromate with the addition of 0.1 percent by volume of concentrated sulfuric acid. Apply with a stiff bristle brush, and leave for approximately 30 seconds before thoroughly rinsing and drying.
3) Alternatively, a proprietary product, which is intended for this purpose, may be used according to manufacturer's recommendations.
4) Check coating thickness in the affected areas to ensure that the zinc coating remaining after the removal of wet storage stain is sufficient to meet or exceed the requirements of the specification.

2.9 SHOP PRIMING

A. Steel Primer(s):
1. Comply with Section 09 91 13 "Exterior Painting"

2. SSPC-Paint 23, latex primer.
3. Fabricator's standard, fast-curing, lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
    a. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
4. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
5. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
6. Primer, Slip-Critical Connections: For connection faying surfaces, provide a qualified primer with a minimum Class A slip coefficient or higher in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts." Primer shall be compatible with adjacent primers where in contact.

B. Galvanized-Steel Primer: Water-based, MPI #134.

1. Etching Cleaner: MPI#25, for galvanized steel.

C. Galvanizing Repair Paint: Inorganic MPI#19.

D. Shop prime steel surfaces except the following:

1. Surfaces embedded in and in direct contact with concrete, mortar or grout. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Faying surfaces of slip-critical connections to be high-strength bolted.
4. Surfaces to receive sprayed fire-resistive materials.
5. Galvanized surfaces unless indicated to be painted.
6. Corrosion-resisting (weathering) steel surfaces.
7. Surfaces enclosed in interior construction.

E. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7 (WAB)/NACE WAB-4, "Brush-Off Blast Cleaning."
4. SSP C-SP 14 (WAB)/NACE WAB-8, "Industrial Blast Cleaning."
5. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
6. SSPC-SP 6 (WAB)/NACE WAB-3, "Commercial Blast Cleaning."
7. SSPC-SP 10 (WAB)/NACE WAB-2, "Near-White Blast Cleaning."
8. SSPC-SP 5 (WAB)/NACE WAB-1, "White Metal Blast Cleaning."
9. SSPC-SP 8, "Pickling."

F. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

G. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspection agency to inspect shop welds and high-strength bolted connections and tests, and to prepare test reports as indicated in the Drawings and in accordance with “Testing and Inspection” in Part 3.

B. Fabrication Inspection: When approved by the Building Official, the Owner, and Engineer/Architect, full-time special inspection in the fabrication shop by the Owner's Testing Agency may be waived, subject to the following:

1. The Fabricator participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant.
2. All shop inspection is provided by the Contractor, per the requirements herein, and is documented. Reports and test results are to be available for the Owner's Inspector to review.
3. A specific quality control plan for this project shall be developed and submitted to the Structural Engineer for approval prior to the prefabrication/pre-erection meeting.
4. Periodic inspection by the Owner's Inspection Agency is allowed by the Fabricator.
5. Certified Plants: Continuous plant inspection is not required at plants producing prefabricated steel products which are certified by the Building Official.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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

3.2 PREPARATION

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

1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

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

B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.

2. Weld plate washers to top of baseplate.

3. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection, unless it conforms to the requirements of AISC 360 Specification Sections M2.2 and M2.5, and is approved by the Engineer/Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.

G. Do not enlarge unfair holes in members by burning or using drift pins.

H. Reaming: Light drifting will be permitted to draw the parts together, but drifting to match unfair holes will not be permitted. Any enlargement of holes necessary to make connections in the field shall be done by reaming with twist drills, care being taken not to weaken the adjoining metal. If, in the judgement of the Engineer/Architect, the extent of the reaming is such that holes cannot be properly filled or accurately adjusted after reaming, the faulty member shall be discarded and replaced with a new one, and all costs and expenses resulting therefrom shall be paid by the Contractor.

I. Cutting and Fitting: No cutting of sections, either flanges, webs, stems or angles shall be done by the Contractor without the consent of the Engineer/Architect, unless this cutting is particularly specified or shown on the drawings.

J. Corrective Measures

1. Any errors in locations or inaccuracies in the setting of anchor bolts, base plates, bearing plates, or other items of attachment or support for steel work shall be reported to the Engineer/Architect, and shall be corrected in a manner subject to the approval of the Engineer/Architect.

2. Any misfits due to errors in fabrication shall be reported immediately to the Engineer/Architect, along with proposed method of correction of same and Engineer/Architect approval obtained before proceeding with corrective measures.

3. No members shall be cut or burned without specific approval in writing.

4. Bolted or welded connections, joints, or fastenings, which are classified as defective in the opinion of the Engineer/Architect, shall be corrected by the Contractor in a manner subject to the Engineer/Architect’s approval.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

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

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

2. Remove backing bars or runoff tabs, unless noted otherwise, back gouge, and grind steel smooth.

3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

C. Erection Connections, etc: Place holes, plates, or other attachments required by the Erector so as not to interfere with or cause any other detrimental effect to structural members or their connections.

3.5 FIELD QUALITY CONTROL

A. All structural steel is subject to special inspection.

B. Testing and Inspection Agency: Owner will engage a qualified independent testing and inspecting agency to provide inspection and required tests, and to prepare test reports as indicated in the Drawings.

C. Testing and Inspecting Agency Requirements:

1. Special Inspector: Testing Agency shall provide qualified "Special Inspector" who will perform the inspection services.
2. Testing agency will conduct and interpret tests, and state in each report whether test specimens comply with or deviate from requirements.
3. Testing agency will notify the Owner and Engineer/Architect immediately of discrepancies in the work which are time-critical or affect the construction progress.
4. Personnel inspecting connections part of the SFRS shall be qualified per AISC 341.

D. Contractor Responsibilities Related to Shop and Field Inspections:

1. Maintain complete records of all quality control and testing performed by the Contractor.
2. Furnish all electrical power, turning or moving of members, hoisting, staging, and other facilities required for inspection.
3. Provide testing agency with access to places where structural steel work is being fabricated and erected so required inspection and testing can be accomplished.
4. Correct deficiencies in, or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.
5. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
6. Grant Inspectors full authority to inspect all material and work that fails to conform in every respect to these specifications.
7. When required by Engineer/Architect or Owner’s Independent Testing Agency or Contractor’s engaged inspection organization, make adequate platforms available to the Inspector for the purpose of checking high-strength bolts and welds. Scaffolding shall be provided to ensure safe performance of this operation.

E. Shop and Field Tests and Inspections: Inspections and testing shall be performed as indicated in the Contract Documents. Additional requirements are as follows:

1. Bolted Connections: Inspect (and test as required) bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.

    a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:

        1) Liquid Penetrant Inspection: ASTM E165.

2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3) Radiographic Inspection: ASTM E94 and ASTM E142; minimum quality level "2-2T."
4) Ultrasonic Inspection: ASTM E164.

b. Provide testing and inspection of welds for all connections part of the SFRS in accordance with AISC 341 and AWS D1.8.

3. Welded Headed Studs: In addition to visual inspection, test and inspect shop and field welded shear stud connectors in accordance with requirements in AWS D1.1 for stud welding and as follows:

a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
b. Conduct tests in accordance with requirements in AWS D1.1 on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.

3.6 REPAIRS

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to equivalent thickness of galvanized finish and complying with ASTM A780.

B. Touchup, Primers: Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-primed surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup, Primers: Cleaning and touchup are specified in Section 09 91 13 "Exterior Painting."

D. Touchup High Performance Priming: Cleaning and touchup priming are specified in Section 09 960 0 "High-Performance Coatings."

END OF SECTION 05 12 00

SECTION 05 1213
ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel: General requirements for structural steel members, including AESS framing specified in this section.

B. Section 09 9113 - Exterior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.

1.03 DEFINITIONS

A. Architecturally-Exposed Structural Steel: Structural steel complying with designated AESS category as defined in AISC 303.

1.04 REFERENCE STANDARDS

A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges 2016.

B. AISC 360 - Specification for Structural Steel Buildings 2016 (Revised 2021).

C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling 2019.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.

F. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS) 2015.

G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.

H. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

I. SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.05 SUBMITTALS

A. Shop Drawings: Detailing for fabrication of AESS components.
   1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
   2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
   3. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.
   4. Indicate orientation of hollow structural section (HSS) seams and mill marks (where applicable).
   5. Indicate vent or drainage holes for HSS members.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: In addition to those qualifications listed in Section 05 1200, engage an AISC Certified Fabricator, experienced in fabricating AESS similar to that indicated for this project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the work.

B. Erector Qualifications: In addition to those qualifications listed in Section 05 1200, engage an AISC Certified Erector, experienced in erecting AESS work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Comply with Section 05 1200, except as amended in this section for aesthetic purposes.

2.02 FABRICATION

A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Architect. Detail AESS assemblies to minimize field handling and expedite erection.

B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.

C. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.

D. Fabricate AESS in accordance with categories defined in AISC 303, as follows:
   1. AESS 3: Feature elements viewed at a distance less than 20 feet (feature elements in close view).

2.03 PAINT SYSTEM

A. Compatibility: All components/procedures of AESS paint system to comply with coating system specified, submitted, and approved per Sections 09 9113. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.

B. Primer: As specified in Sections 09 9113. Primer to comply with all federal standards for VOC, lead and chromate levels.

2.04 SHOP PRIMING

A. Surface Preparation:
   1. Provide surface preparations to meet SSPC-SP 6.
   2. Provide surface preparations at specified in Section 05 1200 - Structural Steel.
   3. Coordinate required surface profile with approved paint submittal prior to beginning surface preparation.
   4. Prior to blasting, remove any grease and oil using solvent cleaning to meet SSPC-SP 1.
   5. Remove weld spatter, slivers and similar surface discontinuities.
   6. Ease sharp corners resulting from shearing, flame cutting or grinding.

B. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, or high strength bolted with slip-critical connections.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer’s instructions to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.05 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to AESS indicated for galvanizing according to ASTM A123/A123M. Fabricate such that all connections of assemblies are made in the field with bolted connections where possible.

B. All steel exposed to weather shall be hot dip galvanized.

C. All steel exposed to view shall additionally be painted or powdercoated per setion 09 9113 - Exterior Painting.

2.06 MATERIALS

A. General: Meet requirements of 05 1200 as amended below.

2.07 SOURCE QUALITY CONTROL

A. AESS 3,4, and C Acceptance: Architect to observe AESS in the shop at a viewing distance consistent with final installation and determine acceptability based on approved mock-up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Erector to check all AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.

3.02 PREPARATION

A. Provide connections for temporary shoring, bracing and supports only where noted on approved fabrication documents. Temporary connections not shown are to be made at locations not exposed to view in final structure or as approved by Architect.

B. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AESS through process of erection.

3.03 ERECTION

A. AESS 1 and 2: Basic elements; feature elements not in close view:
   1. Employ special care to handle and erect AESS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.
   2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by Architect during pre-installation meeting. Obtain Architect approval of methods for removing temporary devices and finishing AESS members prior to erection.
   3. AESS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of AISC 303.
   4. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
   5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
   6. Remove all backing and run out tabs.
   7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.

B. AESS 3: Feature elements in close view:
   1. Erect to requirements of AESS 1 and 2 and as follows:
   2. Field Welding: Weld profile, quality, and finish to be consistent with mock-ups approved prior to fabrication.
   3. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.

3.04 FIELD QUALITY CONTROL

A. AESS 3,4, and C Acceptance: Architect to observe AESS in place and determine acceptability based on qualification data and submittals as well as on approved mock- up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

END OF SECTION

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. Roof deck.

B. Related requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for structural concrete fill over steel deck.
2. Section 05 12 00 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 05 50 00 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

D. Research/Evaluation Reports: Provide current ICC report for steel deck.

E. Field quality control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Canam Unites States, The Canam Manac Group Inc.
2. CMC Joist & Deck.
3. Nucor Corp., Vulcraft Group.
4. United Steel Deck, Inc.
5. Verco Manufacturing Co.
6. Wheeling Corrugating Company, Div. of Wheeling-Pittsburgh Steel Corporation.

B. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (345 MPa), G60 (Z180) zinc coating.
2. Deck Profile: Type N
3. Profile Depth: 3 inches (76 mm)
4. Design Uncoated-Steel Thickness: 18 gage (0.0478 inches)
5. Span Condition: As indicated on the drawings.
6. Side Laps: Interlocking seam

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Verco VSC-2, or approved equal.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 50,000 psi (345 MPa), not less than 0.0478-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

G. Galvanizing Repair Paint: ASTM A 780.

H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by HILTI X-ENP-19 fasteners, or approved equal, at the pattern indicated on the drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports with Verco VSC-2 fasteners (or approved equal), at intervals indicated on the drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches (38 mm), or as required per the deck manufacturer, whichever is greater, with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

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

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 4000
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cold-formed metal framing and furring in canopy framing.

B. Cold-formed metal framing for furred walls in electrical room.

C. Canopy ceiling sheathing.

1.02 RELATED REQUIREMENTS

A. Section 05 1200 – Structural Steel: Any HSS or other structural steel components within canopy framing as necessary for strength or deflection purposes.

B. Section 07 9200 – Joint Sealants.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.

B. AISI S200-12 – North American Standard for Cold-Formed Steel Framing – General Provisions; American Iron and Steel Institute; 2012.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.

F. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2011c.

G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2011a.

H. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2011 w/Errata.

J. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

1.04 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Include plans and elevations at not less than 1/4 inch to 1'-0" scale, and details at not less than 3 inches to 1'-0" scale.
   1. Indicate framing layout.
   2. Indicate component details, framed openings, bearing, anchorage to structure, type and location of fasteners and accessories, and items required of related work for complete installation of steel stud system.

C. Welding Certificates: If welding is to be used.

D. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
   1. Steel sheet.
   2. Expansion anchors.

3. Power-actuated anchors, subject to limitations of Statewide Alternate Method OSSC No. 08-02.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

E. Research/Evaluation Reports: Current ICC Evaluation Reports for cold-formed metal framing and products listed above.

F. Structural Calculations: Provide structural calculations signed and sealed by an engineer registered in the State of Oregon. Calculations shall be provided for all cold formed steel members and their connections to structure. Reference the Structural Drawings for loading requirements.

1.05 QUALITY ASSURANCE

A. Welding: If welding is to be used, qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

B. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

C. Coordination: Coordinate additional metal framing and backing with masonry attachment points, metal panel system attachment points, and rainscreen system attachment points.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing products by manufacturers who are members in good standing of the Steel Stud Manufacturers Association (SSMA), the Steel Framing Industry Association (SFIA), or the Certified Steel Stud Association (CSSA).

2.02 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: ST33H (ST230H), minimum.
2. Coating: G60 (Z180), unless otherwise indicated on the Drawings.

B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: As required by structural performance.
2. Coating: G90 (Z275).

2.03 EXTERIOR FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Base-Metal Thickness: 43 mil minimum.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 43 mil minimum.

C. Furring: "Depth as indicated in Architectural Drawings."

1. Base Metal Thickness: 43 mil minimum.

2.04 SHEATHING

A. Plywood backing for wood ceiling: As specified in Section 06 1000 Rough Carpentry

2.05 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Foundation clips.
   7. Hole reinforcing plates.
   8. Backer plates.

2.06 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Fasteners: Hilti X-U per ICC ESR-2269.
   1. Power-Actuated Fasteners are subject to the limitations of Statewide Alternate Method OSSC No. 08-02.

E. Mechanical Fasteners: Elco Dril-Flex or Hilti Kwik-Flex conforming to ICC Legacy Report ER-4780, dual hardner, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws. The self-drilling point lead tapping threads shall have a minimum hardness of HRL. The load bearing screen shank shall have a maximum of hardness of HRL 34.
   1. Head Type: Hex washer head, undercut flathead, or custom head styles as noted on drawings.

F. Welding Electrodes: Comply with AWS standards.

2.07 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.08 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.

2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding or screw fastening. Wire tying of framing members is not permitted.
    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to the Drawings, with screw penetrating joined members by not less than three exposed screw threads.
4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to the Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Coordinate with work of other trades. Stage framing to complete continuous air barrier.

3.02 PREPARATION

A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete construction.

B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding or screw fastening. Wire tying of framing members is not permitted.
    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to the Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.04 EXTERIOR FRAMING INSTALLATION

A. Install continuous tracks sized to match framing members. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of framing members to tracks, unless otherwise indicated.

C. Install miscellaneous framing and connections, including web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable framing system.

D. Secure sheathing with long dimension perpendicular to framing members, with ends over firm bearing and staggered, using self-tapping screws.

3.05 FIELD QUALITY CONTROL

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

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.06 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, which ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items.

B. Guardrails and handrails at Stage.

C. Equipment supports and access ladders.

D. Embeds in concrete slabs and walls.

E. Downspouts

F. Downspout boots.

G. Miscellaneous fabricated steel items.

1.02 RELATED REQUIREMENTS

A. Items in this Section may overlap or require coordination with items in Section 05 1200 - Structural Steel.

B. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

C. Section 05 1200 - Structural Steel: Structural steel, bearing plates and anchor bolts.

D. Section 09 9113 - Exterior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2014.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

C. ASTM A48/A48M - Standard Specification for Gray Iron Castings 2003 (Reapproved 2021).

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.

E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

F. ASTM A276/A276M-17 - Standard Specification for Stainless Steel Bars and Shapes.

G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.

H. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.

I. ASTM A588/A588M-15 - Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance.

J. ASTM A780/A780M-09 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

K. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

L. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2019, with Editorial Revision (2020).

M. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.

N. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.

O. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel 2018.

P. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).

Q. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

1.04 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

B. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

C. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Steel Plates: ASTM A36/A36M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Stainless Steel: ASTM A276/A276M.

F. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.

G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

J. Anchors: As required to suit and complete application.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by **continuous welds.**

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed butt joints tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

A. Steel embeds in concrete slabs, walls and columns: As detailed in structural drawings.

B. Guardrails at Stage:
   1. Materials: Fabricated steel as detailed.
   2. Finish: Galvanized and powdercoated.
   3. Color: match steel columns.

C. Handrails at Stage:

1. Materials: 1-1/4" stainless steel pipe, Schedule 40.
2. Support Brackets: Fabricated steel, galvanized and powdercoated.
3. Finish: Brushed.
4. Joints: mitered and welded.

D. Equipment Supports and Access Ladders:
1. Materials: Fabricated steel as detailed.
2. Finish: Galvanized and powdercoated.
3. Color: match steel columns.

E. Downspouts:
1. Materials: Steel pipe, schedule 40, with fabricated steel plate brackets as detailed.
2. Support Brackets: Galvanized and painted.
3. Finish: Galvanized and painted.
4. Color: match steel columns.

2.04 DOWNSPOUT BOOTS

A. Downspout Boots: Round, with smooth interior without boxed corners or choke points; include integral lug slots, integral cleanout, cleanout cover, and tamper proof fasteners.
1. Configuration: Straight.
2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
3. Finish: Manufacturer's standard factory applied powder coat finish.
4. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, integral neoprene gaskets, and rubber coupling.

2.05 FINISHES - STEEL

A. Galvanize all exterior fabricated steel items under this section except stainless steel.
1. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
2. Galvanized items to be painted, refer to section 09 9113 - Exterior Painting.

B. Painting: See Section 09 9113 - Exterior Painting.

C. Powdercoating: See Section 09 9113 - Exterior Painting.

2.06 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Grind plug welds and butt joint welds smooth with surrounding surfaces so that surface looks continuous.

F. Obtain approval prior to site cutting or making adjustments not scheduled.

G. After erection, prime welds, abrasionsand surfaces not shop primed or galvanized , except surfaces to be in contact with concrete.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05 5210 – EXTERIOR METAL RAILINGS (GALVANIZED)

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Galvanized steel tube and flat bar guardrails and handrails.

B. Related Sections include the following:

1. Division 03 Section “Miscellaneous Cast-In-Place Concrete” for forming joints and recesses in cast concrete.
2. Division 06 Section “Wood Decking” for wood decking around railing posts.

1.2 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of handrail and railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.

B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:

a. Uniform load of 50 pounds per foot applied in any direction.
b. Concentrated load of 200 pounds per foot applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:

a. Uniform load of 50 pounds per foot applied horizontally and concurrently with 100 pounds per foot applied vertically downward.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:

a. Concentrated load of 200 lbf applied horizontally on an area of 1 sq. ft.
b. Uniform load of 25 lbf/sq. ft. applied horizontally.
c. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Provide railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other

detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 degrees Fahrenheit, ambient; 180 degrees Fahrenheit, material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Grout and anchoring cement.
2. Galvanic paint products.

B. Shop Drawings: Show fabrication and installation of railings. Include plans, elevations, sections, component details, infill and attachments to other Work. Refer to 1.6 - Project Conditions, for field measurements prior to preparation of shop drawings.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, toprails, posts, and balusters.
2. Fittings and brackets.

D. Mock up: provide one full 5 foot section of guardrail with handrail attached for review and approval prior to commencing full fabrication of metal work. All welds shall be representative of the quality produced on the finished product. Apply galvanizing repair paint to several locations on the mockup for review of consistency with galvanized finish.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Welding certificates.

G. Qualification Data: For testing agency.

H. Product Test Reports: From a qualified testing agency indicating railings comply with ASTM E 985, based on comprehensive testing of current products.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of handrail and railing through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

1.5 STORAGE

A. Store railings in a dry, well-ventilated, weathertight place.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, stairs and other construction contiguous with railings by field measurements for inclusion on Shop Drawings. Before proceeding with fabrication, the fabricator is responsible for confirming additional construction or previously unconfirmed built conditions which may affect the work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION AND SCHEDULING

A. 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.

B. 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Steel Tube Railings:

a. Pisor Industries, Inc.
b. Sharpe Products.

c. Wagner, R & B, Inc.; a division of the Wagner Companies.
d. Or equal.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, blemishes and other imperfections where exposed to view on finished units..

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.3 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513, Type 5 (mandrel drawn).

1. Provide galvanized finish for exterior installations and where indicated.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Plates, Shapes, and Bars: ASTM A 36.

D. Castings: Either gray or malleable iron, unless otherwise indicated.

1. Gray Iron: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.
2. Malleable Iron: ASTM A 47.

E. Welded- Wire Mesh: Intermediate-crimp, rectangular pattern, 1.5-inch x 3- inch welded-wire mesh, made from 0.25-inch nominal diameter wire complying with ASTM A 510.

1. Manufacturer: McNichols (www.Mcnichols.com), or approved equal

F. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.4 FASTENERS

A. General: Provide the following:

1. Steel Railings: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

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. Anchors: Provide cast-in-place chemical or torque-controlled expansion anchors as indicated on the Drawings, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

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

E. 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: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 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. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated on the Drawings. 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 will be exposed to weather in a manner to exclude water.

F. Provide weep holes to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.

G. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

H. Connections: Fabricate railings with welded connections, unless otherwise indicated on the Drawings.

I. 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 surfaces smooth and blended leaving no evidence of the welded connection. Welded surfaces shall match the contours of adjoining surfaces with no roughness, undercutting or pin holes present.

J. Form changes in direction as follows:

1. By radius bends of radius indicated on the Drawings.
2. By mitering and welding at elbow bends.

K. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated on the Drawings.

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. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.

1. Orient wire mesh with wires horizontal and vertical.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in the same piece are not acceptable. Retain paragraph below if exposed fasteners are allowed, especially with color anodic finish.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize steel and iron railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A for hot-dip galvanized railings.
3. Comply with ASTM A 153/A for hot-dip galvanized hardware.

B. Fill vent and drain holes that will be exposed in the finished Work, unless utilized as weep holes, by plugging with zinc solder and filing off smooth.

C. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

B. Perform cutting, drilling, and fitting required to install railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.

1. Do not weld, cut, or abrade surfaces of handrail and railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. 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.

B. 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 1 side, and locate joint within 6 inches of post.

3.3 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, 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 or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.5 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.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 5210

SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural dimension lumber framing.

B. Sheathing.

C. Preservative treated wood materials.

D. Fire retardant treated wood materials.

E. Miscellaneous framing and sheathing.

F. Communications and electrical room mounting boards.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Setting anchors in concrete.

B. Section 05 5000 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.

C. Section 06 2000 - Finish Carpentry: Alaskan Yellow Cedar T&G Boards and Planks for ceiling finish.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

C. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing 2010 (Reapproved 2017).

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

E. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.

F. PS 1 - Structural Plywood 2009 (Revised 2019).

G. PS 20 - American Softwood Lumber Standard 2020.

H. WWPA G-5 - Western Lumber Grading Rules 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide technical data on wood preservative materials and application instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

1. Species: Douglas Fir-Larch, unless otherwise indicated.
2. If no species is specified for non-structural members, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

B. All composite wood and laminate adhesives shall be No Added Urea Formaldehyde (NAUF).

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Western Wood Products Association; WWPA G-5.

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: Kiln-dry or MC15, unless noted otherwise in the structural drawings.

D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
1. Lumber: S4S, Construction Grade, unless noted otherwise in the structural drawings.

2.03 EXPOSED DIMENSION LUMBER

A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.

B. Grading Agency: Western Wood Products Association; WWPA G-5.

C. Sizes: Nominal sizes as indicated on drawings.

D. Surfacing: S4S.

E. Moisture Content: as indicated in the structural drawings..

F. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
1. Species: Douglas Fir Larch
2. Grade: As indicated in the structural drawings.

2.04 EXPOSED BOARDS

A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.

B. Moisture Content: Kiln-dry (15 percent maximum).

C. Surfacing: S4S.

D. Species: Douglas Fir.

E. Grade: No. 2, 2 Common, or Construction.

2.05 CONSTRUCTION PANELS

A. Roof and Soffit Sheathing, at Electrical Building: APA PRP-108, Structural I Rated Sheathing, Exterior Exposure Class, and as follows:
1. Span Rating: 24/16.
2. Thickness: 3/4 inch, nominal.

B. Ceiling Sheathing at Stage: PS 1 A-C plywood, pressure treated; 3/4 inch thick.
1. Span rating: 24/16
2. Paint black where exposed to view, reference Section 09 9113 Exterior Painting.

C. Communications and Electrical Room Walls: PS 1 A-D plywood, fire retardant treated; 3/4 inch thick.
1. Paint Color: Same as adjacent wall.

D. Other Applications:

1. Plywood Backing Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade, fire retardant treated.
2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
3. Other Locations: PS 1, C-D Plugged or better.

2.06 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
   1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
   1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

D. Sill Gasket on Top of Concrete Slab: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls. Provide [_____] manufactured by [_____] .

E. Sill Flashing: As specified in Section 07 6200.

2.07 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. (FRT) Fire Retardant Treatment:
   1. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat all exterior rough carpentry items.
      c. Do not use treated wood in direct contact with the ground.

C. (PT) Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber in contact with roofing, flashing, or waterproofing.
      c. Treat lumber in contact with masonry or concrete.
      d. Treat lumber less than 6 inches above grade.
      e. Treat lumber in other locations as indicated.
   2. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
      a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
      b. Treat plywood in contact with roofing, flashing, or waterproofing.
      c. Treat plywood in contact with masonry or concrete.

d. Treat plywood less than 18 inches above grade.
e. Treat plywood in other locations as indicated.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Install horizontal spanning members with crown edge up and not less than 1-1/2 inches of bearing at each end.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. Coordinate with other trades, preference for wood supports or metal strapping.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. At long edges provide solid edge blocking where joints occur between roof framing members.
   2. Nail panels to framing; staples are not permitted.

B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.
   4. Size: 48 by 96 inches, installed horizontally at ceiling height.
   5. Coordinate sizes and precise locations.

3.06 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

C. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.07 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01 7419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 061500 – WOOD DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Wood decking on piers and boardwalk.
2. Wood bench on piers and boardwalk.
3. Wood lean rail on guardrail.

1.2 Related Sections include the following:

1. Division 03 Section "Miscellaneous Cast-in-Place Concrete" for concrete seat wall.
2. Division 05 Section "Exterior metal railing" for metal guardrail and handrail.

1.3 REFERENCES

A. American Lumber Standards Committee (ALSC).

B. American Wood Preservers Association (AWPA).

C. Forest Stewardship Council (FSC).

D. American Society for Testing and Materials (ASTM).

E. American Society of Mechanical Engineers (ASME).

F. Council of American Building Officials (CABO).

G. American Forest and Paper Association (AFPA).

1.4 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.

B. Exposed Framing: Dimension lumber not concealed by other construction and indicated to receive a stained or natural finish.

1.5 SUBMITTALS

A. The Contractor shall make all submittals in accordance with Division 01 – Section “Submittal Procedures”.

B. Product Data: For decking, framing and accessories. Include installation instructions and data on fabrication and treatment processes.

C. Shop Drawings: Show layout of framing, full dimensions of each member, and details of connections.

D. Samples: Full width and depth, 24 inches long, showing the range of variation to be expected in appearance of wood products including treatment and finishing.

E. Certificates of Inspection: Issued by lumber grading agency for exposed decking and framing not marked with grade stamp.

F. Wood-Treatment Certificates: Signed by wood treater certifying that treatment processes comply with requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed construction similar in material design, and extent to that indicated for this Project and with a record of successful in-service performance, with 5 years minimum experience.

B. Black Locust Wood Decking: shall be certified by Forest Stewardship Council (FSC) and/or sustainably and domestically sourced from within the United States.

1.7 PROTECTION, STORAGE and HANDLING

A. Schedule delivery of heavy timber to avoid extended on-site storage and to avoid delaying the Work.

B. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or equal:

1. Wood-Preservative-Treated Materials:

a. Baxter: J. H. Baxter Co.
b. Chemical Specialties, Inc.
c. Continental Wood Preservers, Inc.
d. Hickson Corp.
e. Hoover Treated Wood Products, Inc.

f. Osmose Wood Preserving, Inc.

2. Metal Framing Anchors:

a. Cleveland Steel Specialty Co.
b. Harlen Metal Products, Inc.
c. Silver Metal Products, Inc.
d. Simpson Strong-Tie Company, Inc.
e. Southeastern Metals Manufacturing Co., Inc.

2.2 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard", and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:

1. WCLIB – West Coast Lumber Inspection Bureau.
2. WWPA – Western Wood Products Association.

C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by inspection agency.

D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

1. Provide dressed lumber, S4S, unless otherwise indicated.
2. Provide lumber with 15 percent maximum moisture content at time of dressing for 2 inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

A. General: Where lumber is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA U1. Mark each treated item with the Quality Mark Requirements of an inspection agency approved by the ALSC's Board of Review.

1. Do not use chemicals containing chromium or arsenic.

B. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb./cu.ft.

C. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.4 DIMENSION LUMBER

A. General: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.

1. Grade: Select Structural,

2.5 BOARDS

A. Wood Decking:
1. Sustainably and domestically sourced Black Locust: Black Locust (Robinia pseudoacacia), All material milled from NHLA select and better kiln dried lumber. No. 1 Premium grade or better, 12 percent maximum moisture content, clear, free of knots, splits and checks,plain sawn. Available from: Midwest Black Locust Inc, or equal.
2. Dimension: 5” x 5/4”

B. Documentation confirming the certified status of all wood products shall be submitted to the Owner’s Representative for approval prior to fabrication. The Owner’s Representative may reject wood products for which acceptable documentation is not submitted. FSC-accredited certifying agencies include the SmartWood Program administered by Rainforest Alliance, and the Forest Conservation Program administered by Scientific Certification Systems.

C. Acceptable documentation shall include:

1. A copy of the wood supplier’s certificate issued by one of the above-mentioned certifying agencies.
2. A copy of the supplier’s invoice detailing the quantities of certified wood products supplied for this project
3. A copy of a letter from one of the above-mentioned certifying agencies corroborating that the products detailed on the wood supplier’s invoice originate from certified well-managed forest.

D. Proper procedures shall be followed to ensure that certified wood products are kept separate from non-certified materials and that auditing procedures as mandated by the certifier are complied with.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating per ASTM A 153 or Type 304 stainless steel.

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.
1. Decking screws to be stainless steel have countersunk heads and be tamperproof, square (Robertson) head or approved equal.

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M)

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.7 METAL FRAMING ANCHORS

A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and as follows:

1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for Project.
2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, which meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

B. Joist Hangers: U-shaped joist hangers with minimum 2 inch long seat and 1-1/4 inch wide nailing flanges at least 85 percent of joist depth.

1. Thickness: 0.052 inch.
2. Thickness: 0.064 inch.

C. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and 2 inches minimum side cover, socket 0.064 inch thick minimum, standoff and adjustment plates 0.108 inch thick minimum.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood. Apply end grain sealant to fresh cut ends of Ipe wood, using care not to apply to others surfaces.

E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, comply with the following:

1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.
2. Published requirements of metal framing anchor manufacturer.
3. "Recommend Nailing Schedule" of referenced framing standard ad with the AFPA's "National Design Specifications for Wood Construction".
4. "Table 23-I-Q—Nailing Schedule" of the Uniform Building Code.

F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fastener of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

G. Use hot-dip galvanized or stainless steel screws where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.

H. Countersink screw heads on exposed carpentry work. Arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered unless indicated otherwise in drawings.

I. Install wood decking with crown up (bark side down).

J. Secure decking to framing with hidden fasteners.

3.2 WOOD FRAMING, GENERAL

A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction", unless otherwise indicated.

B. Install framing members of size and at spacing indicated.

C. Do not splice structural members between supports.

3.3 DECK JOIST FRAMING

A. General: Install deck joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows.

1. Where supported on wood members, by toe nailing or by using metal framing anchors.
2. Where framed into wood supporting members, by using wood ledgers as shown or, if not shown, by using metal joist hangers.

B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.

C. Do not notch in middle third of joists; limit notches to 1/6 depth of joist, 1/3 at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than 2 inches from top or bottom.

D. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.

3.4 TIMBER FRAMING

A. Install timber framing with crown edge up and provide not less than 4 inches of bearing on supports. Provide continuous members, unless otherwise indicated; tie together over supports if not continuous.

B. Install wood posts using metal anchors indicated.

C. Treat ends of timber beams and posts exposed to weather by dipping in water-repellant preservative for 15 minutes.

END OF SECTION 06150

SECTION 06 2000
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior wood ceilings and soffits.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

1.03 SUBMITTALS

A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

B. Samples: Submit two samples of finish wood, 4 by 12 inch in size illustrating wood grain and specified finish.

C. Samples: Submit two samples of wood trim and wood soffit 11 inch long.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

2.02 EXTERIOR WOODWORK ITEMS:

A. Exterior Wood Soffits: Clear vertical grain tongue and groove and square edge boards; Alaskan Yellow Cedar, 1 x 4. Clear stain and topcoat 3 sides, back primed.

2.03 LUMBER MATERIALS

A. Concealed lumber material: Pressure treated Douglas Fir.

B. Exterior Softwood Lumber: Alaskan Yellow Cedar species, quarter sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.
   1. Grading: In accordance with rules certified by ALSC; www.alsc.org.

2.04 FASTENINGS

A. Fasteners for Exterior Applications: Hot-dipped galvanized steel complying with ASTM A153/A153M; length required to penetrate wood substrate 1-1/2 inch minimum.

B. Fasteners and clips: Of size and type to suit application, unless specifically noted.

2.05 ACCESSORIES

A. Lumber for Shimming and Blocking: Pressure treated douglas fir.

B. Primer: Alkyd primer sealer.

C. Wood Filler: Solvent base, tinted to match surface finish color.

2.06 WOOD TREATMENT

A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.

B. (PT) Wood Preservative by Pressure Treatment: AWPA U1 Treatment using water borne preservative with 0.25 percent retainage.

2.07 SITE FINISHING MATERIALS

A. Finishing: Field finished as specified in Section 09 9113.

2.08 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

D. Finish per Section 09 9113 - Exterior Painting, and Section 09 9123 Interior Painting.

E. Back prime or seal woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 PREPARATION FOR SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

B. Site Finishing: See Section 09 9113.

C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.04 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 06 7413 – FIBERGLASS REINFORCED GRATINGS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall furnish, and install all fiberglass reinforced plastic (FRP) items, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein, and in accordance with the requirements of the Contract Documents.

1.2 REFERENCES

A. The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein. The publications are referred to within the text by the designation only.

1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) Test Methods:
   a. ASTM D 635 Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position

   b. ASTM E 84 Surface Burning Characteristics of Building Materials

1.3 CONTRACTOR SUBMITTALS

A. Product Data:
1. Manufacturers published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance with referenced standards, test reports as applicable, concrete anchor systems and their allowable load tables.
2. Manufacturer’s color chart.

B. Shop Drawings:
1. For all fabricated gratings and accessories in accordance with the provisions of this Section.
2. For all fabricated gratings and accessories, clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details.

C. Samples:
1. 6”x6” sample of grating in selected color and finish.
2. One grating clip and fastener.

1.4 MOCK UP

A. Create 6'x6' sample of grate installation including clips and fasteners. Obtain review and approval from Owner's Representative prior to proceeding with installation.

B. Remove unapproved mock ups.

C. Accepted mock up may be incorporated into finished work.

1.5 QUALITY ASSURANCE

A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years' experience in the design and manufacture of similar products and systems. Additionally, if requested, a record of at least five (5) previous, separate, similar successful installations in the last five (5) years shall be provided.

B. To meet quality standards and assure grating meets all EPA requirements, grating must be manufactured in North America.

C. Manufacturer shall offer a 3 year limited warranty on all FRP products against defects in materials and workmanship.

D. Manufacturer shall be certified to the ISO 9001-2008 standard.

1.6 PRODUCT DELIVERY AND STORAGE

A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.

B. Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 70 and 85 degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

PART 2 - PRODUCTS

2.1 GENERAL

A. All FRP items furnished under this Section shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

B. Fiberglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.

C. Resin shall be Isophthalic Polyester, with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.

D. All finished surfaces of FRP items and fabrications shall be smooth, resin rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

E. All fire-retardant molded grating products shall have a tested flame spread rating of 25 or less per ASTM E 84 Tunnel Test. Gratings shall not burn past the 25 mm reference mark and will be classified HB per ASTM D635.

F. All mechanical grating clips shall be E-1 hold down clip by Fibergrate and be manufactured of Type 316 L, SS (stainless steel), or approved equal.

G. Fasteners for the E-1 hold down clips shall be tamper-proof, of one type and be manufactured of Type 316L, SS (stainless steel), or approved equal.

2.2 MOLDED FRP GRATING

2.1 MANUFACTURER

A. Molded gratings shall be Fibergrate® as manufactured by

1. Grate: Ecograte 62, one (1) inch thick grates with aqua-grit surface, dark grey color.
2. Clip: E clip stainless steel clip with tamper-proof bolt, washers and nut per manufacturer's recommendation.
3. Manufacturer: Fibergrate Composite Structures Inc. Dallas, TX 1-800-527-4043 www.fibergrate.com, or approved equal.

2.2 GRATE PROPERTIES

A. Grate must have a minimum 62% open area for light transmittance. Open area calculation must include both load and cross bars.

B. Must be ADA compliant with a maximum open space between load bars of 1/2 inch.

C. Depth: 1 inch with a tolerance of plus or minus 1/16 inch.

D. Mesh Configuration: 3/4 inch x 4 inch with a tolerance of plus or minus 1/16 inch mesh centerline to centerline.

E. Load/Deflection: Grating design loads shall be less than manufacturers published maximum recommended loads. Maximum recommended loads shall be determined by acoustic emission testing. Deflection is not to exceed 0.375 inch or L/D = 120, whichever is less. Grating shall meet manufacturer's published safe recommended loadings with deflection not to exceed the following:

1. Maximum deflection of 0.28 inches with a uniform distributed load of 50 pounds per square foot at 42 inch clear span.

F. Manufacture: Grating shall be of a one-piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane. Grating shall have rectangular mesh pattern

providing unidirectional strength. Grating shall be reinforced with continuous roving of equal number of layers in each direction. The top layer of reinforcement shall be no more than 1/8 inch below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance.

G. After molding, no dry glass fibers shall be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

H. Resin system: The resin system used in the manufacture of the grating shall be Corvex®.

I. Grating bar intersections are to be filleted to a minimum radius of 1/16 inch to eliminate local stress concentrations and the possibility of resin cracking at these locations.

J. Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84.

K. Corrosions resistance: Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted.

L. Grating shall be manufactured with a barefoot friendly aqua-grit (sugar grit) to the top surface of each bar providing maximum slip resistance.

1. Resin used to apply texture shall be cured using infrared (IR) heat for maximum durability.

M. Color: Dark Gray

N. The manufacturer shall certify that the stiffness of all panels manufactured is never more than 2.5% below the published load-deflection values.

O. Substitutions: Other products of equal configuration, strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the engineer for approval ten (10) days prior to bid date. Only preapproved substitutions will be considered as meeting the requirements of the specification.

2.3 GRATING FABRICATION

A. Measurements: Grating supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work. When field dimensions are not required, Contractor shall determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.

B. Layout: Each grating section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the contract drawings. Grating openings which fit around protrusions (pipes, cables, machinery, etc.)

shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.

C. Sealing: All shop fabricated grating cuts shall be sealed to provide maximum corrosion resistance. All field fabricated grating cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions and approved sealers.

D. Hardware: Type 316 stainless steel hold down clips shall be provided and spaced at maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

A. Shop inspection is authorized as required by the Owner and shall be at Owner's expense. The fabricator shall give ample notice to Contractor prior to the beginning of any fabrication work so that inspection may be provided. The grating shall be as free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces).

3.2 INSTALLATION

A. Contractor shall install gratings in accordance with manufacturer’s assembly drawings. Fasten grating panels securely in place with hold down clips and tamper-proof fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

END OF SECTION 06 7413

SECTION 07 1113
BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bituminous dampproofing.

B. Protection boards.

C. Drainage panels.

1.02 REFERENCE STANDARDS

A. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal 1997 (Reapproved 2018).

B. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing 2013.

C. NRCA (WM) - The NRCA Waterproofing Manual 2005.

1.03 SUBMITTALS

A. Product Data: Provide properties of primer, bitumen, and mastics.

B. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.05 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.01 BITUMINOUS DAMPPROOFING

A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
   1. Composition - Vertical Application: ASTM D1227 Type III or ASTM D1187/D1187M Type I.
   2. Composition - Horizontal and Low-Slope Application: ASTM D1227 Type II or III.
   3. VOC Content: Not more than permitted by local, State, and federal regulations.
   4. Applied Thickness: 1/16 inch, minimum, wet film.
   5. Products:
      a. W.R. Meadows, Inc.; Sealmastic Emulsion Type I (spray-grade).
      b. Henry Company; HE789 - Fibered Asphalt Emulsion Damproofing (spray grade)..

B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.02 ACCESSORIES

A. Drainage Panel: 1/4 inch thick formed plastic, hollowed sandwich.

B. Protection Board: 1/8 inch thick biodegradable hardboard.
   1. Product: Protection Course PC-2 Standard Duty Type II manufactured by WR Meadows.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.

C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 APPLICATION

A. Scope: Retaining Walls at areas below grade.

B. Above-grade planter walls and slabs.

C. Perform this work in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

D. Prime surfaces in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

E. Apply bitumen with mop.

F. Apply bitumen at a temperature limited by equiviscous temperature (EVT) plus or minus 25 degrees F; do not exceed finish blowing temperature for four hours.

G. Apply bitumen in one coat, continuous and uniform, at a rate of 10 sq ft/gal .

H. Apply from 2 inches below finish grade elevation down to top of footings.

I. Seal items watertight with mastic, that project through dampproofing surface.

J. Place protection board directly over dampproofing, butt joints, and adhere to tacky dampproofing.

K. Scribe and cut boards around projections, penetrations, and interruptions.

L. Backfill with 24-48 hours after application.

END OF SECTION

SECTION 07 1900
WATER REPELLENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water repellents applied to exterior concrete surfaces.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate.

1.03 REFERENCE STANDARDS

A. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete 2013.

B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings 2005 (Reapproved 2018).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and Owner.
   1. Specified mockup shall be available for review at this meeting.

1.05 SUBMITTALS

A. Product Data: Provide product description, details of tests performed, limitations, and chemical composition.

B. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's Field Reports: Report whether manufacturer's "best practices" are being followed; if not, state corrective recommendations. Email report to Architect the same day as inspection occurs; mail report on manufacturer's letterhead to Architect within 2 days after inspection.

E. Manufacturer's Qualification Statement.

F. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience

C. Owner reserves the right to provide continuous independent inspection of surface preparation and application of water repellent.

1.07 MOCK-UP

A. Prepare a representative surface 36 by 36 inch in size using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-ups constitute standard for workmanship.

B. For proposed substitutions, prepare side-by-side mock-ups of specified and substitute products.

C. Locate where directed.

D. Mock-up may remain as part of the Work.

E. Verify compatability of water repellent with joint sealers.

1.08 FIELD CONDITIONS

A. Protect liquid materials from freezing.

B. Do not apply water repellent when ambient temperature is lower than 50 degrees F or higher than 100 degrees F.

1.09 WARRANTY

A. Provide approved manufacturer's standard 5 year warranty for water repellency.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Standard Water Repellent:
   1. Basis of Design: Protectosil, Chem-Trete 40 VOC by Evonik.

2.02 MATERIALS

A. Water Repellents: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
   1. Applications: Exterior and interior exposed masonry and concrete vertical surfaces and non-traffic horizontal surfaces. Refer to Schedule below
   2. Number of Coats: Two.
   3. Moisture Absorption When Applied to Concrete: Five percent, maximum, when tested in accordance with ASTM C642 concrete sample completely coated with water repellent.
   4. Permeability: Product shall maintain 80% of vapor transmission from the original wall construction when tested in accordance with ASTM E96.
      a. Minimum of 8 perms when tested in accordance with ASTM E96.
   5. Maintains dry appearance when wetted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify joint sealants are installed and cured.

C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

3.02 PREPARATION

A. Protection of Adjacent Work:
   1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
   2. Protect adjacent surfaces not intended to receive water repellent.

B. Prepare surfaces to be coated as recommended by water repellent manufacturer for best results.

C. Do not start work until concrete substrate is cured a minimum of 60 days.

D. Remove oil and foreign substances with a chemical solvent that will not affect water repellent.

E. Allow surfaces to dry completely to degree recommended by water repellent manufacturer before starting coating work.

3.03 APPLICATION

A. Apply water repellent in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.

B. Apply at rate recommended by manufacturer, continuously over entire surface.

C. Apply two coats, minimum.

D. Remove water repellent from unintended surfaces immediately by a method instructed by water repellent manufacturer.

3.04 SCHEDULE

A. Apply Water Repellent.
   1. All exterior concrete vertical surfaces..

END OF SECTION

SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Batt insulation and vapor retarder in exterior wall, roof, and soffit construction.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Cold-Formed Metal Framing.

B. Section 06 1000 - Rough Carpentry: Supporting construction for batt insulation.

C. Section 07 2500 - Weather Barriers: Separate air barrier and vapor retarder materials.

D. Section 07 5400 - Thermoplastic Membrane Roofing: Insulation specified as part of roofing system.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C 2019a.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.05 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 BATT INSULATION MATERIALS

A. Mineral Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   2. Thermal Resistance: R-value of 21, minimum, for 6" nominal stud walls.
   3. Thickness: Full Cavity.
   4. Manufacturers, subject to meeting the above requirements:
      a. Thermafiber, Inc:
      b. Roxul, Inc.
      c. Johns Manville.

2.02 ACCESSORIES

A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.

B. Insulation Fasteners for Rigid Wall Insulation at Brick Veneer cladding: Brick ties with washers as specified in Section 04 2001 - Masonry Veneer.

C. Insulation Fasteners for Soffit Insulation: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

D. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.

E. Adhesive: Type recommended by insulation manufacturer for application.
   1. Comply with Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 FIBER BOARD INSTALLATION AT EXTERIOR WALLS

A. Install insulation in accordance with manufacturer's written recommendations using spot fasteners specified. Use of Z-girts for support of insulation is not allowed.

B. Install insulation to maintain continuity of thermal protection to building elements and spaces.

C. Fit insulation closely around electrical boxes, pipes, ducts, frames, masonry ties, structural elements, and other objects in or passing through insulation.

3.03 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Install with factory applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.

F. Staple or nail facing flanges in place at maximum 6 inches on center.

G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

H. At wood framing, place vapor retarder on warm side of insulation by stapling at 6 inches on center. Lap and seal sheet retarder joints over member face.

I. Tape seal tears or cuts in vapor retarder.

J. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

K. Coordinate work of this section with construction of air barrier seal specified in Section 07 2500.

3.04 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 5400
THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Adhered system with thermoplastic roofing membrane.

B. Deck sheathing.

C. Roofing stack boots.

1.02 RELATED REQUIREMENTS

A. Section 07 6200 - Sheet Metal Flashing and Trim: Counterflashings.

B. Section 07 7200 - Roof Accessories: Fall protection anchors.

1.03 REFERENCE STANDARDS

A. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.

B. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing 2021.

C. FM DS 1-28 - Wind Design 2016.

D. NRCA (RM) - The NRCA Roofing Manual 2019.

E. NRCA (WM) - The NRCA Waterproofing Manual 2005.

F. SPRI RP-4 - Wind Design Standard for Ballasted Single-Ply Roofing Systems 2019.

G. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

A. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.

B. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.

C. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

D. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.

E. Installer's Qualification Statement.

F. Warranty Documentation:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's certification that installation complies with warranty conditions for waterproof membrane.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.
   1. With minimum 5 years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

B. Store materials in weather protected environment, clear of ground and moisture.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight.

1.07 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 90 degrees F.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.08 WARRANTY

A. See Division 01 specifications for additional warranty requirements.

B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
   1. Warranty Term: 20 Years.
   2. For repair and replacement include costs of both material and labor in warranty.
   3. Exceptions are not Permitted:
      a. Damage due to roof traffic.
      b. Damage due to wind speed greater than 56 mph but less than 72 mph.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermoplastic Polyvinyl Chloride (PVC) Membrane Roofing Materials:
   1. Carlisle Roofing Systems, Inc; Sure-Flex PVC: www.carlisle-syntec.com/#sle.
   2. Flex Membrane International Corporation; Flex FB PVC: www.flexroofingsystems.com/#sle.
   3. GAF; : www.gaf.com
   4. Johns Manville: www.jm.com/#sle.
   5. Sika Corporation Roofing; Sarnafil PVC: usa.sika.com/sarnafil/#sle.
   6. Versico Roofing Systems; VersiFlex PVC: www.versico.com/#sle.
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOFING

A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered.

B. Roofing Assembly Requirements:
   1. Roof Covering External Fire Resistance Classification: UL (FRD) Class A.

C. Acceptable Insulation Types - Constant Thickness Application: Any type that meets requirements and is approved by membrane manufacturer for application.

D. Acceptable Insulation Types - Tapered Application:

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:
   1. PVC: Polyvinyl chloride (PVC) complying with ASTM D4434/D4434M, Type II, sheet contains reinforcing fibers or reinforcing fabrics.
      a. Thickness: 60 mil, 0.060 inch.
   2. Sheet Width: Factory fabricated into largest sheets possible.
   3. Color: Manufacturer's standard grey.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Flexible Flashing Material: Same material as membrane.

D. Separation Sheet: Sheet polyethylene; 2 mil, 0.002 inch thick.

1. Provide if required by manufacturer.

2.04 DECK SHEATHING

A. Deck Sheathing: Gypsum sheathing, ASTM C1396/C1396M, Type X special fire resistant type, paper face, 1/2 inch thick.

2.05 COVER BOARD

A. High density cover board as recommended by roofing manufacturer.

2.06 ACCESSORIES

A. Flashing Components:
   1. Flexible Flashing: As recommended by membrane manufacturer.
   2. Membrane-Clad Flashings: PVC-coated, heat weldable sheet metal, 24 gage galvanized sheet metal with 20 mil unsupported P VC membrane laminated to one face.
   3. Continuous metal cleat: Galvanized sheet metal, 24 gage, formed edge to accept roof edge and coping.

B. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

C. Membrane Adhesive: As recommended by membrane manufacturer.

D. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

E. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.

F. Sealants: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 WOOD DECK PREPARATION

A. Verify flatness and tightness of joints of wood decking. Fill knot holes with latex filler.

B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

3.03 METAL DECK PREPARATION

A. Install sheathing on metal deck:
   1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
   2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
   3. Tape joints.
   4. Mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations and roofing manufacturer's instructions.
      a. Over entire roof area, fasten sheathing using 6 fasteners with washers per sheathing board.
      b. At roof perimeter to a distance of 4 ft in from edges, fasten sheathing using 6 fasteners with washers per board.

3.04 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.05 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Apply adhesive to substrate at rate of (as required by roofing manufacturer) gal/square. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.

F. Around roof penetrations, seal flanges and flashings with flexible flashing.

G. Coordinate installation of roof drains and sumps and related flashings.

H. Install rib profiles continuous and straight for the entire length of roof, evenly spaced.

3.06 FIELD QUALITY CONTROL

A. Require site attendance of roofing material manufacturers at initial application and completion during installation of the Work.

3.07 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings and other architectural sheet metal fabrications.

B. Sealants for joints within sheet metal fabrications.

C. Other sheet metal items as indicated in Drawings.

1.02 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).

E. CDA A4050 - Copper in Architecture - Handbook current edition.

F. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.03 SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

B. Samples: Submit two samples 12 by 12 inch in size illustrating metal finish color.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Maintain one copy of each document on site.

C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

D. Mock-Up: Construct mock-up of each condition indicated in drawings. Notify Architect for review. Mock-up may remain as part of the Work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. (AZ) Pre-Finished Aluminum Zinc Alloy Coated Steel Sheet: ASTM A792 with AZ50 coating (same material as roofing panels).
   1. Custom color and manufacturer's standard color as scheduled.

B. (GALV) Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; shop pre-coated with PVDF coating.
   1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: Custom color and manufacturer's standard color As scheduled.

C. (SSTL)Stainless Steel: ASTM A666, Type 304, soft temper, 0.0250 inch thick; smooth No. 2B finish.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

G. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

H. Fabricate through-wall flashing and sill pans with end dams, not exposed to view.

2.03 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer: Zinc chromate type.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Seal metal joints watertight.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.05 SCHEDULE

A. Fascia and Cornices:
   1. Material: AZ or GALV.
   2. Thickness: 22 gage.

3. Finish: To be selected from manufacturer's full range of PVDF colors.

B. Miscellaneous Flashing:
1. Material: AZ or GALV.
2. Thickness: 24 gage.
3. Color (Exposed to view from grade): Match adjacent material.
4. Color (Not exposed to view from grade): Gray.

END OF SECTION

SECTION 07 9200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.02 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

D. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2018.

E. ASTM C1311 - Standard Specification for Solvent Release Sealants 2014.

F. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2018.

G. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2019 (Reapproved 2020).

H. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).

I. SWRI (VAL) - SWR Institute Validated Products Directory Current Edition.

1.03 SUBMITTALS

A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Substrates for which laboratory adhesion and/or compatibility testing is required.
   7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   8. Sample product warranty.
   9. Certification by manufacturer indicating that product complies with specification requirements.
   10. SWRI Validation: Provide currently available sealant product validations as listed by SWRI (VAL) for specified sealants.

B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

1.04 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

D. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

1.05 WARRANTY

A. Correct defective work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
1. Adhesives Technology Corporation.
2. BASF Construction Chemicals-Building Systems.
3. Bostik Inc.
4. Dow Corning Corporation.
5. Pecora Corporation.
6. Tremco Global Sealants.
7. W.R. Meadows, Inc.

B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
1. Adhesives Technology Corporation.
2. BASF Construction Chemicals-Building Systems.
3. Bostik Inc.
4. Dow Corning Corporation.
5. Pecora Corporation.
6. Tremco Global Sealants.
7. W.R. Meadows, Inc.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
a. Wall expansion and control joints.
b. Joints between door, window, and other frames and adjacent construction.
c. Joints between different exposed materials.
d. Other joints indicated below.

B. Exterior Joints: Use non-sag non-staining silicone sealant, Type A, unless otherwise indicated.
1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing. Type Q.
2. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant. Type S.
3. Wiring Slots in Concrete Paving: Self-leveling epoxy sealant. Type X.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 01 6116.

2.04 NONSAG JOINT SEALANTS

Type A - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.

2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
5. Color: To be selected by Architect from manufacturer's standard range.
6. Cure Type: Single-component, neutral moisture curing.
7. Service Temperature Range: Minus 20 to 180 degrees F.

Type Q - Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.

2.05 SELF-LEVELING SEALANTS

A. Type S - Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
   3. Color: To be selected by Architect from manufacturer's standard range.
   4. Service Temperature Range: Minus 40 to 180 degrees F.

B. Type X - Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
   1. Composition: Multi-component, 100 percent solids by weight.
   2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
   3. Color: To be selected by Architect from manufacturer's standard colors.
   4. Joint Width, Minimum: 1/8 inch.
   5. Joint Width, Maximum: 1/4 inch.
   6. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.

2.06 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
   2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   3. Open Cell: 40 to 50 percent larger in diameter than joint width.
   4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION

SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Thermally insulated hollow metal doors with frames.

C. Accessories, including glazing, louvers, and matching panels.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.

C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2018.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

I. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.

J. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.

L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.

M. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2007.

N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.

O. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Assa Abloy Ceco or Curries.
   2. De La Fontaine Inc.
   3. Republic Doors.
   4. Steelcraft, an Ingersoll Rand brand.
   5. Stiles.
   6. Substitutions: Reference Division 01 specifications.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
   4. Door Edge Profile: Manufacturers standard for application indicated.
   5. Typical Door Face Sheets: Flush.
   6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
   7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
      a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.

c. Model 2 - Seamless.
d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.

2. Core Material: Polyisocyanurate, 2 lbs/cu ft minimum density.
3. Door Thermal Resistance: R-Value of 9.9 minimum for installed thickness of polyisocyanurate.
4. Door Thickness: 1-3/4 inch, nominal.
5. Weatherstripping: Refer to Section 08 7100.

C. Interior Doors, Non-Fire Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Level 3 - Extra Heavy-duty.
b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 2 - Seamless.
d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
2. Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inch, nominal.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Exterior Door Frames: Full profile/continuously welded type. Single rabbet.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
2. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
3. Frame Finish: Factory primed and field finished.
4. Weatherstripping: Separate, see Section 08 7100.

C. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

D. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inch high to fill opening without cutting masonry units.

E. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

F. Frames at exterior walls: fill with spray foam insulation.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

C. Field paint per paint schedule.

2.06 ACCESSORIES

A. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

B. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

C. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

D. Coordinate installation and hardware with wood doors and aluminum frames, as required.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

B. Coat inside of other frames with bituminous coating to a thickness of 1/16 inch.

C. Fill exterior frames with spray foam insulation.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Install door hardware as specified in Section 08 7100.

D. Coordinate installation of electrical connections to electrical hardware items.

E. Touch up damaged factory finishes.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 08 7100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for hollow metal doors.

B. Thresholds.

C. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. BHMA A156.1 - American National Standard for Butts and Hinges 2016.

C. BHMA A156.3 - American National Standard for Exit Devices 2014.

D. BHMA A156.4 - American National Standard for Door Controls - Closers 2013.

E. BHMA A156.6 - American National Standard for Architectural Door Trim 2015.

F. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders 2015.

G. BHMA A156.18 - American National Standard for Materials and Finishes 2016.

H. BHMA A156.21 - American National Standard for Thresholds 2014.

I. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems Sponsor 2017.

J. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.

K. UL (DIR) - Online Certifications Directory Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

1.05 SUBMITTALS

A. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

B. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.

1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
2. Provide complete description for each door listed.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Fasteners:
   1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
      a. Aluminum fasteners are not permitted.
      b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
   2. Fire-Rated Applications: Comply with NFPA 80.
      a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
      b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.02 HINGES

A. Hinges: Comply with BHMA A156.1, Grade 1.
   1. Provide hinges on every swinging door.
   2. Provide following quantity of butt hinges for each door:
      a. Doors From 60 inches High up to 90 inches High: Three hinges.

2.03 EXIT DEVICES

A. Exit Devices: Comply with BHMA A156.3, Grade 1.
   1. Lever design to match lockset trim.
   2. Provide cylinder with cylinder dogging or locking trim.
   3. Provide exit devices properly sized for door width and height.
   4. Provide strike as recommended by manufacturer for application indicated.
   5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.04 LOCK CYLINDERS

A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
   1. Provide cylinders from same manufacturer as locking device.
   2. Provide cams and/or tailpieces as required for locking devices.

2.05 DOOR PULLS AND PUSH PLATES

A. Door Pulls and Push Plates: Comply with BHMA A156.6.
   1. Pull Type: Straight, unless otherwise indicated.
   2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
      a. Edges: Beveled, unless otherwise indicated.
   3. Material: Aluminum, unless otherwise indicated.

2.06 CLOSERS

A. Closers: Comply with BHMA A156.4, Grade 1.
   1. Type: Surface mounted to door.
   2. Provide door closer on each exterior door.

2.07 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.
   1. Provide stop for every swinging door, unless otherwise indicated.

2.08 THRESHOLDS

A. Thresholds: Comply with BHMA A156.21.
   1. Provide threshold at each exterior door, unless otherwise indicated.

2. Type: Flat surface.
3. Material: Aluminum.
4. Threshold Surface: Fluted horizontal grooves across full width.
5. Field cut threshold to profile of frame and width of door sill for tight fit.
6. Provide non-corroding fasteners at exterior locations.

2.09 WEATHERSTRIPPING AND GASKETING

A. Weatherstripping and Gasketing: Comply with BHMA A156.22.
   1. Head and Jamb Type: Adjustable.
   2. Door Sweep Type: Encased in retainer.
   3. Material: Aluminum, with brush weatherstripping.

2.10 SILENCERS

A. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
   1. Single Door: Provide three on strike jamb of frame.
   2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
   3. Material: Rubber, gray color.

2.11 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
   1. Primary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list, unless noted otherwise on drawings.
   1. Mounting heights in compliance with ADA Standards:

D. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.02 ADJUSTING

A. Adjust hardware for smooth operation.

B. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.03 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

END OF SECTION

SECTION 09 6900
ACCESS FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stage electrical trench access cover.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Requirements for floor flatness and levelness.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

1.04 SUBMITTALS

A. Product Data: Provide manufacturer's data sheets including loading capacities, materials, finishes, dimensions of components, profiles, and accessories.

B. Shop Drawings: Indicate floor layout, appurtenances or interruptions, edge details, grilles.

PART 2 PRODUCTS

2.01 TRENCH ACCESS COVER

A. Modular aluminum floor access cover system with non-slip cover, sized per drawings.

B. Manufacturers:
   1. Surespan floor ducting access cover and frame with SureGrip Non-Slip cover; www.surespancovers.com
      a. FACTA C load rated.
   2. BALCO ACA-12-500 access cover and cast in place frame; www.balcousa.com
   3. Substitutions: Reference Divison 01 specifications.

2.02 ACCESSORIES - LOW-PROFILE FIXED HEIGHT

A. Grommet Units: Base units with pass-through for power harnesses and communication cables.

2.03 FABRICATION

A. Fabrication Tolerances:
   1. Access Cover Flatness: Plus or minus 0.02 inch in any direction.
   2. Access Cover Width or Length From Specified Size: Plus or minus 0.02 inch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements are as indicated on shop drawings.

B. Verify that substrates comply with tolerances, dimensioned clearances, and other requirements specified in other sections, and that substrates are clean, dry, and free of conditions and deleterious substances that might interfere with system installation.

C. Verify that required utilities are available, in proper location, and are ready for use.

D. Start of installation constitutes acceptance of project conditions.

3.02 PREPARATION

A. Vacuum clean substrate surfaces.

3.03 INSTALLATION - LOW-PROFILE FIXED HEIGHT ACCESS COVER

A. Install components in accordance with manufacturer's instructions.

B. Control traffic across access flooring during installation to ensure floor capacity is not exceeded.

3.04 TOLERANCES

A. Maximum Out of Level Floor Panel Tolerance: 1/16 inch in 10 ft, non-cumulative.

B. Gap Between Panels: 1/16 inch.

3.05 PROTECTION

A. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 09 9113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, zinc, and lead.
   7. Floors, unless specifically indicated.
   8. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Shop-primed items.

1.03 REFERENCE STANDARDS

A. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating 2005 (Reapproved 2017).

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.

C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition.

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

E. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

F. SSPC-SP 6 - Commercial Blast Cleaning 2007.

G. SSPC-SP 13 - Surface Preparation of Concrete 1997 (Reaffirmed 2003).

1.04 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   4. Manufacturer's installation instructions.
   5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.

3. Allow 30 days for approval process, after receipt of complete samples by Architect.
4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.

C. Manufacturer's Instructions: Indicate special surface preparation procedures.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
2. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
1. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
2. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints, Stains and Transparent Finishes:
1. Benjamin Moore & Co.
2. Glidden Professional, a product of PPG Architectural Coatings.
3. Rodda Paint Company; [_____]: www.roddapaint.com/#sle.
4. Sherwin-Williams Company; [_____]: www.sherwin-williams.com/#sle.
5. Miller.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.

2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
5. Supply each paint material in quantity required to complete entire project's work from a single production run.
6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Flammability: Comply with applicable code for surface burning characteristics.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-TR-W - Stain on Wood.
1. Applications: Exterior Wood Soffits and Associated Wood.
2. 3-Coat System.
a. Coat 1: Stain: MPI #33, #90, #156.
b. Coat 2 and 3: Two coats of MPI #194 transparent topcoat.

B. Paint E-TR-C - Transparent Finish on Concrete Floors:
1. Applications: Exterior concrete pavement and floors at Bandshell.
2. Sealer: Water Based Sealer for Concrete Floors; MPI #99.
3. Sealer Sheen:
a. Eggshell: MPI gloss level 3; use this sheen at all locations.

C. Paint ME-OP-3A - Ferrous Metals, Unprimed, Two-Component Polyurethane.
1. Applications: Exposed structural steel.
2. First Coat: Zinc-rich primer, applied at 2.5-3.5 mils dry film thickness.
3. Second Coat: Polyamide Epoxy, applied at 3.0-5.0 mils dry film thickness.
4. Finish Coat: Aliphatic Polyurethane, applied aty 2.0-3.0 mils dry film thickness.
5. Sheen: Semi-gloss.

D. Paint MgE-OP-3L - Galvanized Metals, Latex, 3 Coat: Applications include exterior galvanized steel.
1. One coat galvanize primer.
2. Semi-gloss: Two coats of latex enamel; MPI #15, #163.

2.04 POWDER COATING

A. Paint E-PC - Metal, Powdercoating

B. Shop applied to steel and galvanized steel where specified.

C. Powdercoat applicator is responsible for preparing metal to accept powdercoat.

D. Electrostatically applied PVDF coating meeting AAMA 2605.

E. Semi-gloss finish, color as scheduled.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
   2. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi at 6 to 12 inches. Allow to dry.
   3. Clean concrete according to ASTM D4258. Allow to dry.
   4. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

G. Asphalt, Creosote, or Bituminous Surfaces: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.

H. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

I. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

J. Copper: Remove contamination by steam, high pressure water, or solvent washing.

K. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1 Solvent Cleaning.
   2. Prepare surface according to SSPC-SP 7 Brush Off Blast Cleaning.

L. Ferrous Metal:
   1. Prepare surface according to SSPC-SP 10 Near-White Metal Blast Cleaning.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance.

E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.

F. Sand wood and metal surfaces lightly between coats to achieve required finish.

G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 1400
SIGNAGE

PART 1 GENERAL

1.01 SUMMARY

A. This section is only for signage associated with the Band shell. See other sections for site signage.

1.02 SECTION INCLUDES

A. Band shell directional signage.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

1.04 SUBMITTALS

A. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, sign and letter sizes, fonts, and colors.
   1. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
   2. Submit for approval by Owner through Architect prior to fabrication.

B. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Store tape adhesive at normal room temperature.

PART 2 PRODUCTS

2.01 SIGN TYPES

A. Exterior Flat Signs: Signage media without frame.
   1. Material: Aluminum with factory applied paint suitible for exposed exterior applications.
   2. Edges: Square.
   3. Corners: Radiused.

B. Color and Font: Unless otherwise indicated:
   1. Character Font: Keivit Pro Medium.
   2. Character Case: Upper case only.
   3. Background Color: To be selected by Architect.
   4. Character Color: Contrasting color.

2.02 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
   1. Total Thickness: 1/8 inch.

B. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
   1. Total Thickness: 1/8 inch.

2.03 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

B. Exposed Screws: Chrome plated.

C. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and per Drawings.

B. Install neatly, with horizontal edges level.

C. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 11 6171-RESIDENT PRODUCTION LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Scope: Furnish, assemble, and install all production lighting fixtures, and related accessories. Aim and focus all production lighting fixtures while training designated Owner's personnel in the proper use and care of the instruments.

B. Related Requirements: Drawings and general provisions of the Contract, including General and Special Conditions and other Division-01 General Requirement sections, apply to the work in this section.

C. Refer to the TP series drawings for production lighting fixtures for the stage.

1.2 PRICES AND PAYMENT PROCEDURES

A. Allowances: There are no allowance items in this section.

B. Unit Prices: There are no unit price requirements in this section.

C. Refer to Division 01 for additional project details. All production lighting fixtures shall include labor for assembly, hanging, and focusing.

D. Substitutions:
   1. As required under Division 01, except where additional requirements are listed in this and other individual Sections referenced herein.
   2. All bids shall be submitted based exactly on the contents and brand/models as specified of the TP drawings.
   3. No product or device may be substituted without written authorization from the Theater Consultant. TELEPHONE REQUESTS FOR APPROVAL WILL NOT BE ALLOWED. Only properly completed and signed CSI Substitution Request Forms with full technical catalog data sheets will be considered.
   4. Pre-bid approval of substitute product manufacturers does not relieve the contractor and/or the product manufacturer from compliance with the functional and operational requirements of the Specifications. All products will be carefully evaluated during the submittal review process. If, at that time, any pre-bid approved substitute is found to be unsatisfactory and not in compliance, the contractor then must re-submit and supply the specified product(s) without additional costs to the Owner and/or delay to project.

E. If a manufacturer is listed in this section of the Specification as an approved equivalent, but no specific product model is listed, then the Contractor must submit complete factory technical data sheets and a Bill of Materials of the factory's interpretation of equivalent product, along with their CSI request. Such submittal shall be handled in review as a pre-bid substitution request.

1.3 ADMINISTRATIVE REQUIREMENTS

A. The equipment and services covered under this section of the specifications shall not be quoted by the vendors as bundled with the equipment and services of Sections 26 09 61 & 26 09 62, but shall stand by themselves as a separate quotation to the contractor.

B. A specialty stage lighting vendor (SSLV), local to the project area, shall be utilized to handle the work of this section of the specifications. The vendor shall be well versed in theatrical lighting systems from both a technical and artistic perspective. The vendor shall provide to the contractor, all the services defined within this specification section. The following companies are pre-approved only for their technical capabilities, to serve as SSLV. See item D below for complete qualification requirements:
   1. Stagecraft Industries – Portland, Oregon & Seattle, Washington (503) 286-1600
   2. Hollywood Lights, Inc – Portland, Oregon & Seattle, Washington (503) 232-9001
   3. PNTA – Seattle, WA (206) 267-1787

C. The Contractor and the manufacturers, whose products are selected by the Contractor, shall provide fully assembled units (ready to hang and use) documented in detail in the submittals.

D. Because the work described herein includes the provision of jobsite installation labor, each of the candidates listed above shall provide the Contractor with a fully detailed qualification statement that the firm is licensed as a contractor in the state where the project is located. Include documenting evidence that the firm is a licensed contractor, and as such, that the firm is and shall continue to be in compliance with state requirements for bonding, insurance, prevailing wage and hour regulations for the type of work described in this specification. SSLV candidate firms who do not or cannot provide such documentation shall not be acceptable.

1.4 SUBMITTAL REQUIREMENTS

A. Submittals for Review: Furnish a detailed Bill of materials for all work, including manufacturer's catalog cuts for each type of lighting instrument. Furnish catalog cuts for all Accessories. Cross-reference each item with the fixture or accessory ID number from the TP series drawings.

B. If the Architect or Theater Consultant do not discover missing or conflicting elements in the submittals that are in conflict with the contract documents, the Contractor and the manufacturers are still required to comply with the contract documents.

1.5 REFERENCES

A. Abbreviations and Acronyms: Refer to TP series drawings for any special definitions related to this work

B. Definitions: Refer to TP series drawings for any special definitions related to this work

C. Reference Standards:

1. The following listed codes, standards, and regulations refer to the latest current edition and are to be considered a part of this Section: ASTM, AISC, NEC, NESC, NEMA, NFPA, UL, IEEE, ANSI, USITT, ESTA, OSHA, and OSSC.
2. All equipment where applicable standards have been established shall be listed and labeled by Underwriter's Laboratories or other locally approved testing agency. All Lighting Instruments and Electrical Accessories shall be UL listed and labeled for use as theatrical lighting.
3. Contractor is responsible for insuring compliance with all applicable building, product, and installation codes (including but not limited to the IBC and NEC) that are in effect at the time of the installation. Corrections to any product, assembly or work performed under this contract to obtain code compliance shall be at contractor's expense.
4. Custom assemblies shall meet all applicable codes and where local jurisdictions require shall be inspected and approved by the local code authority at the Contractor’s expense.
5. Custom field assemblies shall meet all applicable codes and where local jurisdictions require shall be inspected and approved by the local code authority at the Contractor’s expense.

1.6 TEMPORARY FACILITIES AND CONTROLS

A. Temporary Use of Permanent Work: Refer to Division 01 requirements.

B. Additional to Division 01 requirements, use of fixtures and devices provided under this section shall require the Contractor to clean and refurbish item(s) to “as new out of box” condition.

PART 2 - PRODUCTS

2.1 STANDARD ACCESSORIES

A. Each luminaire shall be provided with the standard accessories as listed on the TP series Drawings.

2.2 LED ZOOM WASH LIGHT, RGBW – IP65 RATED

A. Furnish, install, configure and aim as per this section of the specification, in quantities as defined on the TP series drawings.

B. Approved Manufacturer and Product:
1. Chauvet Professional: Colorado 2-Quad Zoom IP65. Provide with:
    a. Unistrut, Bolt, Nut and pressure washer.
    b. Power-Con IP65
    c. One Meter Power Cord with L5-20P
    d. Diffusion Holder and Frame
    e. #107-89116-1030 Opti-Flecs Diffusion
2. Or prior approved by Addendum

2.3 PRODUCTION LIGHTING ACCESSORIES

A. Furnish and install accessories as needed to execute the production lighting plot, and deliver remainder to Owner with allocated inventory. Equipment package shall be in types and quantities as defined on the TP series drawings.

PART 3 - EXECUTION

3.1 PRODUCTION LIGHTING HANGING PLOT

A. Execute a production lighting hanging plot for all new fixtures and accessories. The hanging plot shall be provided by the Theater Consultant. Use the accessories as listed in the TP series drawings, to execute a fully functional hang. Record any deviations made in the field, for an As-Built version of the hang and focus plot.

B. Hanging of fixtures shall include setting of digital addresses for intelligent or LED units, and coordination with lighting controls provider for RDM integration with configuration of lighting controls. Test all fixtures for fully compliant operation with project lighting console and other lighting control sources which are set to have control access to production fixtures and accessories.

C. After completion of assembly, fixture hang and user training, provide a record copy of actual plot documentation in both AutoCAD and Adobe PDF file formats to Owner and to Consultant for record.

3.2 TRAINING

A. Provide an experienced trained production lighting specialist to perform up to 4 hours of on-site implementation and instruction to the Owner or designated representatives regarding the proper use, operation and maintenance procedures for the luminaires concurrent to the training for the dimming system specified elsewhere.

B. Trained production lighting specialist shall demonstrate proper use, hanging, safety practice, aiming and blending of each type of production lighting fixture. Similar depth of training shall be performed for all production lighting accessories.

3.3 TESTING

A. Test each fixture and all related accessories for proper functionality and safe operation while connected in place to the distribution devices covered under specification section 260962 and powered by the tested and operational lighting control system covered under specification section 260961.

3.4 WARRANTY/GUARANTEE

A. All major components shall carry a manufacturer's and/or installer's warranty, which shall guarantee against defects in materials and workmanship for a period of two years, commencing at Final Completion. Refer to Division 01 for requirements related to Closeout Procedures & Closeout Submittals for other general requirements.

B. Warranty must include all shipping expenses including, but not limited to, return shipping of items which do not meet these specifications.

C. The warranty period shall not start until Final Completion.

D. The Contractor shall warrant materials and workmanship of systems and equipment installed as free of defects. The Contractor shall guarantee in writing the repair or replacement within two calendar weeks for any item found defective during the warranty period as defined in 3.4, A above. Ordinary wear and defects due to improper usage is an exception.

E. During the warranty period, all emergency conditions where system failures may be hazardous or may cause severe hardship or cancellation of events and performances shall be responded to within 24 hours.

F. If start of warranty is delayed due to delay in contractor completing the punchlist items, and owner has commenced use of the facility, the Contractor shall provide the same level of service and responsibility defined herein.

G. Contractor shall honor and service warranty on LED light engines. Warranty period for lamps shall start at approved completion of services described in this section of the specification.

3.5 CLOSE-OUT DOCUMENTS

A. Comply with requirements as set forth in Division 01, except where specific requirements listed in this Section are more stringent.

B. Operation/Maintenance Manuals: Provide operation and maintenance manuals. Manuals shall consist of operation, safety, and maintenance recommendations. Operation and maintenance manuals shall include parts data, and written warranty/guarantee. Refer to Division 01 for general requirements related to Closeout Procedures & Closeout Submittals for Operation & Maintenance Manuals.

END OF SECTION 11 6171

SECTION 11 6800 – PLAY FIELD EQUIPMENT AND STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following site furnishings:

1. Play Equipment.
2. Splash Pad.

B. Related Sections include the following:

1. Division 31 Section “Earth Moving” for subgrade preparation, grading, base course under structures, and drainage course under play surfacing.
2. Division 03 Section "Cast-in-Place Concrete" for concrete footings.
3. Division 32 Section “ Playground Protective Surfacing” for protective surfacing materials under and around play equipment.

1.2 DEFINITIONS

A. Fall Height: According to ASTM F 1487, "the vertical distance between a designated play surface and the protective surfacing beneath it."

B. HDPE: High-density polyethylene.

C. IPEMA: International Play Equipment Manufacturers Association.

D. LLDPE: Linear low-density polyethylene.

E. MDPE: Medium-density polyethylene.

F. Use Zone: According to ASTM F 1487, the "area beneath and immediately adjacent to a play structure or equipment that is designated for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting the equipment."

1.3 QUALITY ASSURANCE:

A. Manufacturing standards: provide each item of equipment as a complete unit produced by a single manufacturer, including fittings, accessories, bases and anchorage devices.

B. Manufacturer Qualifications: A firm whose playground equipment components have been certified by IPEMA's third-party product certification service.

1. Provide playground equipment and play structure components bearing the IPEMA Certification Seal.

C. Installer Qualifications: An employer of workers approved by manufacturer.

D. Safety Standards: Provide playground equipment complying with or exceeding requirements in ASTM F 1487

E. Construction: Construct each item and ship to the site in minimum number of sections.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, field-assembly requirements, and installation details.

B. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

C. Shop Drawings: Provide Shop Drawings utilizing field verified dimensions, include below and above grade utilities and structures indicating their proximity to the proposed play equipment. Provide installation and leveling methods for each type of site furnishing, including hardware intended to be utilized. Shop drawings shall include plans, elevations, sections, details, and attachments to other work. Include dimensioned drawings and calculations for equipment footings provided by the product manufacturer and stamped and signed by a Structural Engineer licensed in the State where the project resides. If conflicts arise between shop drawings and the Drawings, notify Owner’s Representative before proceeding with the Work.

D. Coordination Drawings: Plans, drawn to scale and based upon field verified dimensions on which, the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Extent of surface systems and use zones for equipment.
2. Critical heights for playground surfaces and fall heights for equipment.
3. Dimensional relationships between play equipment and all above and below grade site elements and utilities.

E. Maintenance Data: For play equipment and site furnishings equipment with finishes to include in maintenance manuals.

F. Product Data: For manufacturers other than those specified, submit two sets of shop drawings, manufacturer's technical data and installation instructions for each play structure, 12 calendar days prior to Bid Opening for approval by Owner. Bids received without prior approval will be denied.

G. Manufacturer shall provide lumber grade certification.

H. Material Certificates: For the following items, signed by manufacturers:

1. Shop finishes.
2. Wood-Preservative Treatment: Include certification by treating plant that states type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

3. Recycled plastic.

I. Field quality-control reports.

1.5 INSURANCE

A. Each play equipment manufacturer shall provide the City of Albany an ACORD Insurance Policy in the minimum amount of $1,000,000 for product liability Insurance.

PART 2 - PRODUCTS

2.1 PLAY EQUIPMENT

A. The following items specified shall be manufactured by: Columbia Casade Company. Contact: David Gaston. Phone: (503) 332-4308.
1. Tower and Slide: 4500-MA.
2. Triple Arch Climber: NO.1676.
3. Double belt/Double Tot Swing: NO.1563-4.
4. Single Nest Swing: NO. 1555-1-PL
5. Log Scramble: 4500-301.
6. Pole Climber: 4500-209

B. The following items specified shall be manufactured Landscape Forms.
1. Saddle spinner.
2. Double bobble spring rider.
3. Curva Spinner.
4. Standup seesaw.

2.2 Splash Pad.
1. Manufacturer: Vortex.
2. Contact: Len Fransen. Ross Recreation Equipment. 503-407-4890.

2.3 ACCESSORIES

A. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality; tamperproof, vandal and theft resistant; concealed, recessed, and capped or plugged. Provide as required for site furnishing assembly, mounting, and secure attachment.

B. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout for exterior applications as recommended in writing by manufacturer,.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces or conditions where site furnishings are to be erected with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.

B. Notify the Owner's Representative of any conditions detrimental to the proper and timely completion of the work. Do not proceed with installation until unsatisfactory conditions have been corrected and are acceptable to the installer. Notify Owner's Representative for observation of layout prior to installation.

3.2 INSTALLATION, GENERAL

A. General:

1. Assemble and install all products in accordance with the manufacturer's written installation instructions, as modified or shown on the Drawings, and as approved by the Owner's Representative. Obtain approval of layout location from Owner's Representative prior to installing.
2. Comply with manufacturer's recommendations, unless more stringent requirements are indicated. Complete field assembly of site and street furnishings, where required.
3. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
4. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.
5. Pole Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
6. For installing items requiring concrete footings within concrete, asphalt or gravel paving, install item and footing prior to paving. Allow paving to be placed over top of footing. Where this is not feasible, see subparagraph below.

B. Play Equipment:

1. Each piece of play equipment shall be accompanied by bills of materials, written instructions, and erection plan view drawings to be furnished within 2 weeks of Bid Opening and also a copy shipped with the delivery of the play equipment. To facilitate assembly, each part shall be stenciled with an easily-read identification number keyed to the bills of material and erection drawings. All components shall be shipped unitized, protectively wrapped, banded for mechanical handling and ready for assembly.
2. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Anchor playground equipment securely, positioned at locations and elevations indicated.
3. Maximum Equipment Height: Coordinate installed heights of equipment and components with finished elevations of protective surfacing. Set equipment so fall heights and elevation requirements for age group use and accessibility are within

required limits. Verify that playground equipment elevations comply with requirements for each type and component of equipment.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections: For playground and playground equipment and components prior to substantial completion and to certify compliance with ASTM F 1487
1. Perform tests and submit results to Owner’s Representative prior to Substantial Completion of the project, restrict access to installed equipment until approval of test and inspection results.

C. Prepare test and inspection reports.

D. Notify Architectand Owner 48 hours in advance of date and time of final inspection.

3.4 CLEANING

A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION 11 6800

SECTION 12 9300- SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following site furnishings:

1. Bollards.
2. Benches.
3. Picnic tables.
4. Trash Receptacles.
5. Bicycle Racks.
6. Wood benches.
7. Custom wood benches.

B. Related Sections include the following:

1. Division 31 Section “Earth Moving” for excavation for installation of concrete footings.
2. Division 03 Section "Cast-in-Place Concrete" for concrete footings.
3. Division 03 Section "Cast-in-Place Concrete" for installation of anchor bolts cast in concrete footings and for formed voids in concrete.

1.2 QUALITY ASSURANCE:

A. Manufacturing standards: provide each item of equipment as a complete unit produced by a single manufacturer, including fittings, accessories, frames, bases and anchorage devices.

B. Construction: construct each item and ship to the site in minimum number of sections.

C. Conflicts: Compare manufacturer's shop drawings of all products with the products shown on the Drawings. If conflicts arise between shop drawings and the Drawings, notify Owner’s Representative before proceeding with the Work.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, field-assembly requirements, and installation details.

B. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

C. Samples: For each exposed product and for each color and texture specified.

D. Shop Drawings: Submit manufacturer's shop drawings of all products for approval by Owner’s Representative prior to fabrication or supplying. Shop drawing shall include

installation and leveling methods for each type of site furnishing, including hardware intended to be utilized.

E. Maintenance Data: For site furnishings to include in maintenance manuals.

F. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Bench Replacement boards No fewer than two full-size units for each size indicated.
2. Trash Receptacle Inner Containers: Five full-size units.

PART 2 - PRODUCTS

2.1 SITE FURNISHINGS

A. Products: Subject to compliance with requirements, provide the following:

1. Bollards:
   a. Removable Bollard
      1) Manufacturer: Reliance Foundry. 1-877-789-3245.
      2) Model: #R-7902 for both fixed and removable bollard.
      3) Finish: Black textured.
      4) Mounting: Removable receiver with lid for removalbe bollards; Fixed embedded mount for fixed bollards.

2. Park Bench:
   a. Manufacturer: DuMor Inc..1-800-598-4018.
   b. Model: Bench-165-60 PL.
   c. Color: Black metal with recycled plastic color to be selected by Landscape Architect from manufacturer’s full range.

3. Picnic Tables.
   a. Manufacturer: Outdoor Creations Inc. 1-530-365-6106.
   b. Model: 92” picnic tables w/ round legs. 100SRE.

4. Trash Receptacles:
   a. Manufacturer: DuMor Inc..1-800-598-4018.
   b. Model: Receptacle 148, 32 gal.
   c. Accessory: DM cover.
   d. Color: Black (non textured).

5. Bicycle Racks:

   a. Manufacturer: Columbia-Cascade. 1-800-547-1940.
   b. Model: 2170-3-02.
   c. Finish: Stainless Steel.

6. Wood Benches:

    a. Manufacturer: Landscape Forms.
    b. Contact: Emily Noh. 269-276-4439.
    c. Model: Link Bench, inline, full backrest, straight, end arms, metal legs.
    d. Wood: Exterior graded, Thermally modified ash.
    e. Metal: Powder coated metal, color TBD.

7. Custom Wood Benches:
    a. Manufacturer: Landscape Forms.
    b. Contact: Emily Noh. 269-276-4439.
    c. Model: Custom designed Link Bench, per drawings.
    d. Wood: Exterior graded, Thermally modified ash.
    e. Metal: Powder coated metal, color TBD.

2.2 ACCESSORIES

A. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or non-corrodible materials; commercial quality; tamperproof, vandal and theft resistant; concealed, recessed, and capped or plugged. Provide as required for site furnishings' assembly, mounting, and secure attachment.

B. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by manufacturer, for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.

B. Notify the Owner’s Representative of any conditions detrimental to the proper and timely completion of the work. Do not proceed with installation until unsatisfactory conditions have been corrected and are acceptable to the installer. Notify Owner’s Representative for observation of layout prior to installation.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions, unless more stringent requirements are indicated. Complete field assembly of site and street furnishings, where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed. Obtain approval of layout location from Owner's Representative prior to installing.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Support posts in position during placement and finishing operations until concrete is sufficiently cured.

E. When installation requires concrete footings within concrete, asphalt or gravel paving, install item and footing prior to paving. Allow paving to be placed over top of footing. Where this is not feasible, see subparagraph below.

F. For installing products in sawcut or blocked-out concrete or asphalt paving, match exposed grout, concrete, or asphalt with color and texture of surrounding pavement.

G. Where anchor bolts are exposed after setting of site furnishing, cut tops of bolts flush with nut and grind smooth. Apply matching finish.

3.3 CLEANING

A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION 12 9300

SECTION 22 0500-COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. The intent of Division 22, Plumbing and the accompanying Drawings is to provide a complete and workable facility with complete systems as shown, specified and required by applicable codes. Include all work specified in Division 22, Plumbing and shown on the accompanying Drawings, including appurtenances, connections, etc., in the finished job.

B. Division 22, Plumbing and the accompanying Drawings are complementary and as binding as if called for by both. Items shown on the Drawings are not necessarily included in the Specifications and vice versa. Specifications supersede drawings in case of conflict.

C. The Drawings that accompany the Division 22, Plumbing, are diagrammatic. They do not show every offset, bend, tee, or elbow which may be required to install work in the space provided and avoid conflicts. Offsets and transitions assumed at a minimum at each duct crossing, structural penetrations through shear walls or beams, structural grids where ceiling heights are restricted, and at piping mains. Follow the Drawing as closely as is practical to do so and install additional bends, offsets and elbows where required by local conditions from measurements taken at the Building, subject to approval, and without additional cost to the Owner. The right is reserved to make any reasonable changes in fixture location prior to roughing-in, without cost impact.

D. The General and Supplemental Conditions apply to this Division, including but not limited to:
   1. Drawings and specifications.
   2. Public ordinances, permits.
   3. Include payments and fees required by governing authorities for work of this Division.

1.2 RELATED SECTION

A. Division 01, General Requirements

B. Division 22, Plumbing

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Products and equipment prohibited from containing pentabrominated, octabrominated and decabrominated diphenyl ethers. Where products or equipment within this specification contain these banned substances, provide complying products and equipment from approved manufacturers with equal performance characteristics.
   2. General:
      a. Conform work and materials to local and State codes, and Federal, State and other applicable laws and regulations.
   3. Responsible for obtaining and payment for permits, licenses, and inspection certificates required in accordance with provisions of Contract Documents.

B. New materials and equipment. Work of good quality, free of faults and defects and in conformance with the Contract Documents.

C. Build and install apparatus to deliver its full rated capacity at the efficiency for which it was designed.

D. Operate the entire plumbing system and apparatus at full capacity without objectionable noise or vibration.

E. Materials:
   1. Meet detailed requirements of the Drawings and Specifications and suitable for the installation shown.

F. Workmanship:
   1. General:
      a. Install materials in a neat and professional manner.
   2. Manufacturer's Instructions:
      a. Follow manufacturer's directions where they cover points not specifically indicated.
      b. If in conflict with the Drawings and Division 22, Plumbing, obtain clarification before starting work.

G. Cutting and Patching:
   1. Cutting, patching, and repairing for the proper installation and completion of the work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting performed by skilled craftsmen of each respective trade in conformance with the appropriate Division of Work.
   2. Additional openings required in building construction made by drilling or cutting. Use of jackhammer is specifically prohibited.
   3. Fill holes which are cut oversize so that a tight fit is obtained around the sleeves passing through.
   4. Do not pierce beams or columns without permission of Architect and then only as directed.
   5. Restore new or existing work cut or damaged to its original condition. Where there are alterations disturb lawns, paving, walks, etc., repair, refinish, and leave in condition existing prior to commencement of work.

1.4 SUBMITTALS

A. Product Data:
   1. Submit product data for review as required by each specification section or by Drawing notes. Include manufacturer's detailed shop drawings, specifications and data sheets.
   2. Manufacturer's abbreviations or codes are not acceptable.

B. Submission Requirements:
   1. Product Data:
      a. Refer to Division 01, General Requirements for additional requirements related to submittals.
      b. Submit electronic copies of product data for Work of Division 22, Plumbing in PDF format with each item filed under a folder and labeled with its respective specification section number, article, and paragraph and mark, if applicable.

c. Include a complete index in the original submittal. Indicate both original items submitted and note stragglers that will be submitted at a later date to avoid delay in submitting.
d. The bulk of the product data to be included with the original submittal. Partial submittals will not be accepted.

C. Contractor Responsibilities:
1. Submit submittals at one time and are in proper order.
2. Ensure materials will fit in the space provided.
3. Assure that deviations from Drawings and Specifications are specifically noted in the submittals. Failure to comply will void review automatically.

1.5 AS-BUILT DRAWINGS

A. Provide record drawings in hard copy and pdf format. Drawings include the following:
1. Project specific titleblock.
2. Notations reflecting the as built conditions of any additions to or variations from the construction documents provided as part of the RFIs, ASIs, Owner Changes, and Field Coordination.

1.6 PROJECT CONDITIONS

A. Existing Conditions:
1. Prior to bidding, verify and become familiar with existing conditions by visiting the site, and include factors which may affect the execution of this Work.
2. Include related costs in the initial bid proposal.

B. Coordinate exact requirements governed by actual job conditions. Check information and report any discrepancies before fabricating work. Report changes in time to avoid unnecessary work.

C. Coordinate shutdown and start-up of existing, temporary, and new systems and utilities. Notify Owner, City, and Utility Company.

1.7 WARRANTY

A. Provide a written guaranty covering the work of this Division (for a period of one calendar year from the date of acceptance by the Owner) as required by the General Conditions.

B. Provide manufacturer’s written warranties for material and equipment furnished under this Division insuring parts and labor for a period of one year from the date of Owner acceptance of Work of this Division.

C. Correct warranty items promptly upon notification.

1.8 TEST REPORTS AND CERTIFICATES

A. Submit one copy of test reports and certificates specified herein to the Architect.

1.9 SUBSTITUTIONS

A. Submit requests for product substitutions in accordance with the Instructions to Bidders and the General and Supplemental Conditions.

PART 2 - PRODUCTS

2.1 PIPE SLEEVES

A. Exterior Wall Sleeves: Cast iron.

B. On Grade Floor Sleeves: Same as exterior wall sleeves.

2.2 FLOOR, WALL AND CEILING PLATES

A. Furnish stamped split type plates as follows:
   1. Floor Plates: Cast brass, chromium plated
   2. Wall and Ceiling Plates: Spun aluminum

PART 3 - EXECUTION

3.1 SLEEVES

A. Exterior Wall Sleeves Below Grade:
   1. Provide water tight sleeves. Install at pipes entering building below grade and where shown. Adjust to provide positive hydrostatic seal.
   2. Responsible for following manufacturer's procedure for installing and tightening seal. Secure sleeves against displacement.

B. On Grade Floor Sleeves: Same as below grade exterior wall sleeves, caulked from inside.

C. Exterior Wall Sleeves Above Grade: Similar to interior wall sleeves except caulk outside with Tremco Dymeric Sealant.

D. Do not support pipes by resting pipe clamps on floor sleeves. Provide supplementary members so pipes are floor supported.

E. Special sleeves detailed on drawings take precedence over this Section.

3.2 CLEANING

A. General: Clean piping of stampings and markings (except those required by codes), iron cuttings, and other refuse.

B. Additional requirements are specified under specific Sections of this Division.

3.3 ACCESSIBILITY

A. General: Locate cleanout fittings conveniently and accessibly with reference to the finished building.

3.4 FLOOR, WALL AND CEILING PLATES

A. Install on piping passing through finished walls, floors, ceilings, partitions, and plaster furrings. Plates completely cover opening around pipe.

B. Secure wall and ceiling plates to pipe, insulation, or structure.

C. Plates not to penetrate insulation vapor barriers.

D. Plates not required in mechanical rooms or unfinished spaces.

3.5 PAINTING

A. General:
   1. Coordinate painting of mechanical items with products and methods in conformance with the appropriate Division of Work, Painting.
   2. Exposed work under this division receives either a factory painted finish or a field prime coat finish.

B. Exterior Black Steel Pipe: Wire brush and apply two coats of rust-inhibiting primer and one coat of exterior enamel. Painting schemes comply with ANSI A13.1.

3.6 ADJUSTING AND CLEANING

A. Before operating any systems make thorough check to determine that systems have been flushed and cleaned as required.

END OF SECTION 22 0500

SECTION 22 2113-PIPE AND PIPE FITTINGS PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Cast Iron Soil Pipe, Service Weight (No-Hub)

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 22, Plumbing

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Piping material and installation to meet requirements of the local plumbing, fire, and building codes and serving utility requirements.

B. Pipe Cleaning: If pipe gets plugged or should foaming of water systems occur, disconnect piping, reclean, and reconnect without additional expense to the Owner.

C. Correct damages to the building or systems resulting from failure to properly clean the system without additional expense to the Owner.

1.4 SUBMITTALS

A. Submit the following:
   1. List of piping materials indicating the service it is being used for. (Do not submit piping product data).

B. Test Reports and Certificates: Submit certificates of inspections and pipe tests to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. As indicated.

2.2 CAST IRON SOIL PIPE, SERVICE WEIGHT (NO-HUB)

A. General: A code approved hubless system conforming to Cast Iron Soil Pipe Institute Standard 301.

B. Pipe and Fittings:
   1. Service weight hubless cast iron conforming to ASTM A 888, marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.
   2. Manufacturers:
      a. Tyler
      b. AB&I
      c. Charlotte

C. Gaskets: Compression type conforming to ASTM C 564.

D. Above Grade Couplings: Band type coupling in conformance with Cast Iron Soil Pipe Institute (CISPI) 310-90, consisting of stainless-steel clamp, and corrugated shield assemblies with a neoprene sealing sleeve ANSI A21.6, ANSI A21.10 Fittings.
   1. Buried: Husky 28-gauge 304 stainless steel hubless type clamp and orange corrugated shield assemblies (80-inch pound torque) with neoprene sealing gaskets (ASTM-C-564), or Clamp-All (125-inch pound torque), 24 gauge 304 stainless steel hubless type clamp, and shield assemblies with neoprene sealing gaskets (ASTM-C-564).
   2. Service:
      a. Storm drain.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measurements, Lines and Levels:
   1. Check dimension at the building site and establish lines and levels for work specified in this Section.
   2. Establish inverts, slopes, and manhole elevations by instrument, working from an established datum point. Provide elevation markers for use in determining slopes and elevations in accordance with Drawings and Specifications.
   3. Use established grid and area lines for locating trenches in relation to building and boundaries.

3.2 EXCAVATION AND BACKFILL

A. General:
   1. Perform necessary excavation and backfill required for the installation of mechanical work in accord with Division 02, Existing Conditions
   2. Repair pipelines or other work damaged during excavation and backfilling.

B. Excavation:
   1. Excavate trenches to the necessary depth and width, removing rocks, roots, and stumps.
   2. Include additional excavation to facilitate utility crossovers, additional offsets, etc.

3. Excavation material is unclassified. Width of trench adequate for proper installation of piping.
4. Widen trench if not wide enough for a proper installation.

C. Bedding:
1. Cast iron, steel, and copper piping full bedded on sand.
2. Place a minimum 4-inch-deep layer on the leveled trench bottom for this purpose.
3. Remove the sand to the necessary depth for piping bells and couplings to maintain contact of the pipe on the sand for its entire length.
4. Lay other piping on a smooth level trench bottom so that contact is made for its entire length.

D. Backfill:
1. Place in layers not exceeding 8 inches deep, and compact to 95 percent of standard proctor maximum density at optimum moisture content.
2. Earth backfill free of rocks over 2 inches in diameter and foreign matter.
3. Disposal of excess material as directed.
   a. Interior: Backfill under interior slabs bank sand or pea gravel.
   b. Exterior:
      1) Excavated material may be used outside of buildings at the Contractor's option.
      2) First 4-inches sand, and final 12-inch layer course soil.

3.3 PIPING INSTALLATION

A. Install piping as to drain. Install according to manufacturer's recommendations.

B. Utility Marking:
1. Installed over the entire length of the underground piping utilities.
2. Install plastic tape along both sides and the center line of the trenches at the elevation of approximately 12-inches above the top of utility.

C. No-Hub Couplings: Install per manufacturer's instructions.

3.4 PIPING JOINTS

A. Pipe and fittings joined using methods and materials recommended by manufacturer in conformance with standard practice and applicable codes. Cleaning, cutting, reaming, grooving, etc. done with proper tools and equipment. Hacksaw pipe cutting prohibited.

B. Above Grade No-Hub Couplings: Install in accordance with manufacturer recommendations.

3.5 ADJUSTING AND CLEANING

A. General:
1. Clean interior of piping before installation.

END OF SECTION

SECTION 22 40 00-PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Drainage Products

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 22, Plumbing

1.3 SUBMITTALS

A. Submit the following:
   1. Product data for each item specified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers are stated for each fixture specified. The following manufacturers are also acceptable, except when indicated only.

B. Drainage Products:
   1. J.R. Smith
   2. Josam
   3. Sioux Chief
   4. Zurn
   5. Wade
   6. Watts Drainage

C. Other Manufacturers: Submit substitution request.

2.2 DRAINAGE PRODUCTS

A. RD-1 Roof Drain (Small Area): J.R. Smith1330 Series, 8-1/2-inch low profile diameter dome, cast iron body with flashing clamp, no-hub outlet and under deck clamp.

B. GD-1 Gutter Drain: J.R. Smith 1640T, 6-inch diameter flat strainer, 45-degree bend, cast iron body.

C. DSN-1 Downspout Nozzle: J.R. Smith 1770 Series in nickel bronze.

PART 3 - EXECUTION

A. Cleanout:
   1. Where shown or required.
   2. Cover set flush with finished surface.

END OF SECTION

SECTION 26 0500- COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. The intent of Division 26, Electrical Specifications and Drawings is to provide a complete and workable facility, with complete systems as required by applicable codes, as indicated, and as specified.

B. Include work specified in Division 26, Electrical and as indicated on Drawings. Include appurtenances, connections, fasteners, and accessories required to make a complete working system, whether indicated or not indicated.

C. Refer to Division 01, General Requirements.

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 REFERENCES

A. The latest adopted revisions of the publications listed below apply to these Specifications as referenced:

1.	IBC	International Building Code
2.	NEC	National Electrical Code
3.	NFPA	National Fire Protection Association
4.	NEMA	National Electrical Manufacturers Association
5.	NECA	National Electrical Contractors Association
6.	ANSI	American National Standards Institute
7.	IEEE	Institute of Electrical and Electronic Engineers
8.	UL	Underwriters Laboratories
9.	OAR	Oregon Administrative Rules

1.4 SYSTEM DESCRIPTION

A. Ground Systems:
   1. Provide complete ground systems indicated.
   2. Include conduit system, transformer housings, switchboard frame, and neutral bus, motors, and miscellaneous grounds required by Contract Documents and by applicable codes.

B. System Identification:
   1. Clearly identify elements of the Project electrical system to indicate the loads served, or the function of each item of equipment, connected under this work.

2. Comply with requirements of Division 26, Electrical, and with applicable codes.

C. Drawings:
1. Drawings are diagrammatic. They do not show every offset, bend, tee, or elbow, which may be required to install work in the space, provided and avoid conflicts with other construction.
   a. Prior to installing work, take field dimensions, and note conditions available for, installation.
   b. Follow the Drawings as closely as practical to do so, and install additional bends, offsets, and elbows where required by installation conditions.
      1) Additional offsets, bends, and other connectors are subject to approval by Project Engineer.
      2) Install additional offsets, bends, and other connectors without additional cost to Owner.
   c. The right to make any reasonable changes in outlet location prior to roughing in is reserved to the Owner's Representative.
2. Luminaire Designations:
   a. Lower case letters adjacent to devices or luminaires indicate switching arrangement or circuit grouping.
   b. Numbers adjacent to devices indicate circuit connection.
3. Circuits and Switching:
   a. Do not change branch circuiting and switching indicated; nor combine homeruns, without Engineer's prior approval.
   b. Do not combine or change feeder runs.
4. Circuit Conductors:
   a. Cross or hash marks on conduit runs indicate quantity of No. 12 copper branch circuit conductors, unless otherwise noted.
   b. Where such marks do not appear, provide quantity of circuit conductors to the outlets shown to perform the control or circuiting indicated.
   c. Include ground, travelers, and switch legs required by the circuiting arrangement indicated.
   d. Provide a dedicated neutral conductor with each circuit. Do not use a shared neutral conductor between phases unless, requested or directed.

1.5 SUBMITTALS

A. Comply with Division 01, General Requirements.

B. Contractor Responsibilities:
1. Submit submittals one time and in proper order.
2. Ensure equipment will fit in the space provided.
3. Deviations from the Drawings and Specifications specifically noted in the submittals. Failure to comply will automatically void any implied approval for use of the equipment on this project.

C. Shop Drawings and Equipment Data:
1. Combine electrical shop drawings and equipment data in Submittal binders.
2. Include in Submittal binders:
   a. Complete index of materials and equipment as required by Specifications to be documented by submittals.

b. Fully describe equipment furnish per manufacturer's detailed specifications.
c. All deviations from the Drawings and Specifications, noted on the submittals. Failure to comply will automatically void any implied approval for use of the equipment on this project.

D. Installation Drawings:
1. Submit prior to starting installation.
2. Show outlets, devices, terminal cabinets, conduits, wiring, and connections required for the complete system described.

E. Record Drawings:
1. Keep record drawings up to date as the work progresses.
2. Show changes, deviations, addendum items, change orders, corrections, and other variations from the Contract Drawings.
3. Keep record drawings at the jobsite and available for the Architect's review.
4. At the completion of the work, incorporate all deviations from the installation drawings to indicate as-built conditions.

F. Operation and Maintenance Data:
1. As specified in Division 01, General Requirements.
2. Provide a separate manual or chapter for each system as follows:
a. Low Voltage Distribution System.
b. Lighting System.
c. Lighting Control System.
3. Description of system.
4. Operating Sequence and Procedures:
a. Step-by-step procedure for system start-up, including a pre-start checklist.
1) Refer to controls and indicators by nomenclature consistent with that used on panels and in control diagrams.
b. Detailed instruction in proper sequence, for each mode of operation (i.e., day-night, staging of equipment).
c. Emergency Operation:
1) If some functions of the equipment can be operated while other functions are disabled, give instructions for operations under those conditions.
2) Include here only those alternate methods of operations (from normal) which the operator can follow when there is a partial failure or malfunctioning of components or other unusual condition.
d. Shutdown Procedure:
1) Include instructions for stopping and securing the equipment after operation.
2) If a particular sequence is required, give step-by-step instructions in that order.
5. Preventive Maintenance:
a. Schedule for preventive maintenance.
1) State the recommended frequency of performance of each preventive maintenance task such as cleaning, inspection, and scheduled overhauls.
b. Cleaning: Provide instructions and schedules for all routine cleaning and inspection with recommended lubricants.
c. Inspection: If periodic inspection of equipment is required for operation, cleaning, or other reasons, indicate the items to be inspected and give the inspection criteria.
d. Provide instructions for lubrication and adjustments required for preventive maintenance routines. Identify test points and given values for each.

6. Manufacturers' Brochures:
   a. Include manufacturers' descriptive literature covering devices and equipment used in the system, together with illustrations, exploded views, and renewal parts lists.
   b. Clearly define manufacturers' standard brochures so that the information applying to the actual installed equipment.
7. Results of performance testing, as specified in PART 3 of this Section.

G. Submittals Procedures:
1. Review and recommendations by the Architect or Engineer are not to be construed as change authorizations.
2. Either if discrepancies are discovered between the materials or equipment submitted, and the Contract Documents, prior to or after the data is processed, the Contract Documents govern.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Products and equipment comply with Oregon Revised Statute (ORS) 453.005(7)(e) prohibiting pentabrominated, octabrominated, and decabrominated diphenyl ethers. Where products or equipment within this specification contains these banned substances, provide complying products and equipment from approved manufacturers with equal performance characteristics.
2. Provide work and materials conforming to:
   a. Local and State codes.
   b. Federal and State laws and regulations.
   c. Other applicable laws and regulations.
3. Obtain and pay for all permits, licenses, and inspection certificates required by authorities having jurisdiction.
4. Pay any other fees required by governing authorities for work of this Division.

B. Install only electrical products listed by a recognized testing laboratory or approved in writing by the local inspection authority as required by governing codes and ordinances.

1.7 SITE VISITATION

A. Visit the site prior to bidding and become familiar with existing conditions and other factors which may affect the execution of the work. Complete coordination of installation of equipment with prior bid packages previously issued. Include related costs in the initial bid proposal.

1.8 COORDINATION

A. Coordinate Work of This Division with all other trades to ensure proper installation of electrical equipment.
1. Review Drawings of other trades or crafts to avoid conflicts with cabinets, counters, equipment, structural members, and other possible impediments to electrical work.
2. Report potential conflicts to the Architect prior to rough-in.
3. Proceed with rough-in following Architect's directives to resolve conflicts.
4. Architectural Drawings govern.

B. Verify the physical dimension of each item of electrical equipment to fit the available space. Contractor's responsibility includes:
   1. Coordination of the equipment to fit into the available space.
   2. Access routes through the construction.

C. Layout Drawings:
   1. Equipment arrangement shown on Drawings is diagrammatic to indicate general equipment sizing and spatial relationship. Include, as part of distribution equipment submittal, a scaled floor plan, which includes equipment shown with their submitted sizes. Include all feeder conduit routing, both aboveground and underground, including termination points at equipment. Submit for Engineer's review prior to commencing work.
   2. Provide additional wiring details at switchboards and other areas where work is of sufficient complexity to warrant additional detailing for coordination.
   3. Submit layout drawings for approval prior to commencing field installation.

D. Where electrical connections are required for equipment provided as Work of other Divisions, coordinate rough in and wiring requirements for that equipment with its supplier and installer prior to commencing work. Notify Architect and Engineer of any discrepancies between the actual rough in and wiring requirements, and those identified on Drawings for resolution prior to installation.

E. Arrange raceways, wiring, and equipment to permit ready access to switches, motors, and control components.
   1. Keep doors and access panels clear.

F. Coordinate electrical, telephone, and other utility services with the appropriate serving utility.
   1. No additional compensation will be allowed the Contractor for connection fees or additional work or equipment required by the serving utility, but not covered in the Drawings or Specifications.

G. Coordinate underground work with other contractors working on the site.
   1. Coordinate particularly with contractors installing storm sewer, sanitary sewer, water, and irrigation lines to avoid conflicts.
   2. Common trenches may be used with other trades, providing clearances required by codes and ordinances are maintained.

H. Coordinated Shop Drawings.
   1. Prepare in two-dimensional format.
   2. Include but are not limited to:
      a. Superplot plans of below groundwork with a colored overlay of all trades including, but not limited to, structural footings and foundation, civil piping, and power conduit to a minimum of 1/2-inch equals 1-foot scale.

1.9 CHANGE ORDERS

A. Supplemental cost proposals by the Contractor accompanied with a complete itemized breakdown of labor and materials. At the Architect's request, make available estimating sheets for the supplemental cost proposals. Separate and allocate labor for each item of work.

1.10 WARRANTY

A. Provide a written warranty covering the work of this Division as required by the General Conditions.
   1. Incandescent Lamps: Excluded from this warranty.

B. Apparatus:
   1. Free of defects of material and workmanship and in accord with the Contract Documents.
   2. Built and installed to deliver its full rated capacity at the efficiency for which it was designed.
   3. Operate at full capacity without objectionable noise or vibration.

C. Include in Contractor's warranty for Work of Division 26, Electrical system damage caused by failures of any system component.

1.11 ALLOWANCES

A. Comply with Division 01, General Requirements.

1.12 ALTERNATES

A. Comply with Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where specified materials or methods conflict with applicable codes, the more stringent requirement applies.

B. Provide apparatus built and installed to deliver its full rated capacity at the efficiency for which it was designed.

C. Ensure that entire electrical system operates at full capacity without objectionable noise or vibration.

D. Materials and Equipment:
   1. Use materials and equipment that are:
      a. New

b. Quality meeting or exceeding specified standards.
c. Free of faults and defects.
d. Conforming to Contract Documents.
e. Of size, make, type, and quality specified.
f. Suitable for the installation indicated.
g. Manufactured in accordance with NEMA, ANSI, UL, or other applicable standards.
h. Otherwise as specified in Division 01, General Requirements.

2. Equipment not meeting all requirements will not be acceptable, even though specified by name.
3. Where two or more units of the same class of equipment are furnished, use products of the same manufacturer.
   a. Component parts of the entire system need not be products of same manufacturer.
4. Basis of Design:
   a. Consider the Basis of Design equipment scheduled or specified by performance or model number.
   b. If other equipment is provided in lieu of the Basis of Design equipment, assume responsibility for all changes and costs which may be necessary to accommodate this equipment, including, but not limited to:
      1) Different sizes and locations for connections.
      2) Different dimensions.
      3) Different access requirements.
      4) Other differences.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Provide a complete properly operating system for each item of equipment specified.
2. Install materials in a neat and professional manner.
3. Comply with equipment manufacturer's written instructions, the best industry practices, and the Contract Documents.
4. Comply with latest published NECA Standard of Installation and provide competent supervision.

B. Clarification:
1. Where there is a conflict among manufacturer's instruction, best practice, and the Documents, request clarification from the Architect prior to rough-in.
2. Architect's decision will be final.
3. Remove and correct work installed without clarification at no cost to the Owner.

C. Existing concrete, block, or brick walls are considered not accessible and may require use of Surface Mounted Raceway (SMR) if existing concealed raceway and device boxes are not available for reuse or do not meet the intent of the design (i.e., proximity to egress path, point of use, etc.). Coordinate route and installation where SMR is required with the Architect/Engineer prior to rough-in. Responsible for reinstalling SMR routed without such prior approval to the Architect's satisfaction.

D. Existing stud walls (wood or metal) with or without blocking with plaster, plasterboard, or paneling finish are considered accessible with accessible ceiling, attic, tunnel, or crawl space above, below, or adjacent. Remove, patch, and repair finished surface as required to conceal rough in for new device locations. If it is determined that a specific instance will not permit concealment of rough-in due to obstructions such as beams, headers, and other structural elements, prior approval before rough-in from the Architect is required.

3.2 EXCAVATION AND BACKFILL

A. Perform all necessary excavation and backfill for the installation of electrical work in compliance with Division 31, Earthwork.

B. Direct Burial Cable or Non-Metallic Conduit:
   1. Minimum 3-inch cover of sand or clean earth fill placed around the cable or conduit on a leveled trench bottom.
   2. Lay steel conduit on a smooth level trench bottom, so that contact is made for its entire length.
   3. Where the electrical conduit is being laid, remove water from trench.

C. Place backfill in layers not exceeding 8-inches deep and compact to 95 percent of maximum density at optimum moisture to preclude settlement.
   1. Interior: Bank sand or pea gravel.
   2. Exterior: Excavated material with final 8-inches clean soil.

D. Following backfilling, grade all trenches to the level of surrounding soil. Dispose excess soil at the site as directed.

E. Provide 6-inches wide vinyl tape marked ELECTRICAL in backfill, 12-inches below finished grade, above all high voltage cable or conduit runs.

F. Coordinate patching of all asphalt or concrete surfaces disturbed by this work with General Contractor.

3.3 EQUIPMENT CONNECTIONS

A. General:
   1. Provide complete electrical connections for all items of equipment requiring such connections, including incidental wiring, materials, devices, and labor necessary for a finished working installation.
   2. Verify the location and method for connecting to each item of equipment prior to roughing-in.
   3. Check the amperage, maximum overcurrent protection, voltage, phase, and similar attributes of each item of equipment before rough in and connection.

3.4 EQUIPMENT SUPPORT

A. Minimum Support Capacity:
   1. Provide fastening devices and supports for electrical equipment, luminaires, panels, outlets, and cabinets capable of supporting not less than four times the ultimate weight of the object or objects fastened to or suspended from the building structure.

B. Luminaire Supports:
   1. Support luminaires from the building structure.
   2. Use supports that provide proper alignment and leveling of luminaires.
   3. Where permitted at exposed luminaires, install flexible connections neat and straight, without excess slack, and attached to the support device.

C. Support all junction boxes, pull boxes, or other conduit terminating housings from roof to prevent sagging or swaying.

D. Conduits:
   1. Support suspended conduits 1-inch and larger from the overhead structural system with metal ring or trapeze hangers and threaded steel rod having a safety factor of four.
   2. Anchor conduit installed in poured concrete to the steel reinforcing with No. 14 black iron wire.

E. Powder actuated or similar shot-in fastening devices will not be permitted for any electrical work except by special permission from the Architect.

3.5 ACCESS DOORS

A. Location and size of access doors is Work of Division 26, Electrical.

B. Furnishing and installation of access doors is work of Division 08, Openings.

3.6 ALIGNMENT

A. Install panels, cabinets, and equipment level and plumb, parallel with structural building lines.

B. Install distribution equipment and electrical enclosures fitted neatly, without gaps, openings, or distortion.

C. Properly and neatly, close unused openings with approved devices.

D. Fit surface panels, devices, and outlets with neat, appropriate, trims, plates, or covers without overhanging edges, protruding corners, or raw edges.

3.7 CUTTING AND PATCHING

A. General:
   1. Comply with Division 01, General Requirements.

2. Restore to original condition new or existing work cut or damaged by installation, testing, and removal of electrical Work.
3. Patch and finish spaces around conduits passing through floors and walls to match the adjacent construction, including painting or other finishes.
4. Clean up and remove all dirt and debris.

B. Make additional required openings by drilling or cutting.

C. Cut oversize fill holes so that a tight fit is obtained around the objects passing through.
1. In rated construction, comply with Division 07, Thermal and Moisture Protection.

D. Obtain Architect's permission and direction prior to piercing beams or columns.

E. Where alterations disturb lawns, paving, walks, and other permanent site improvements, repair and refinish surfaces to condition existing prior to commencement of work.

3.8 PROTECTION OF WORK

A. Protect electrical work and equipment installed under this Division against damage by other trades, weather conditions, or any other causes.
1. Equipment found damaged or in other than new condition will be rejected as defective.

B. Keep switchgear, panels, luminaires, and electrical equipment covered or closed to exclude dust, dirt, and splashes of plaster, cement, paint, or other construction material spray.
1. Equipment not free of contamination is not acceptable.

C. Provide enclosures and trims in new condition, free of rust, scratches, and other finish defects.
1. If damaged, properly refinish in a manner acceptable to the Architect.

3.9 UNINTERRUPTED SERVICE

A. Maintain electrical service to all functioning portions of the site throughout construction.

B. Pre-arrange with Owner outages necessary for new construction.
1. Comply with Division 01, General Requirements.
2. Apply for scheduled shutdowns minimum 4 weeks prior to time needed and reconfirm a minimum of 72 hours prior to time needed.
3. Contractor is liable for any damages resulting from unscheduled outages or for those not confined to the pre-arranged times. Damages include costs incurred by the Owner and by the Owner's tenants.

C. Maintain signal and communication systems and equipment in operation at all times.
1. Outages of these systems shall be treated the same as electrical power outages.

D. Maintain telephone services in accordance with Division 01, General Requirements.

3.10 DEMOLITION AND SALVAGE

A. General:
   1. Remove or relocate all electrical wiring, equipment, luminaires, etc., as may be encountered in removed or remodeled areas in the existing construction affected by this work.
   2. Disconnect electrical service to hard-wired equipment scheduled for removal under other Divisions of Work.
   3. Wiring which serves usable existing outlets restored and routed clear of the construction or demolition.
   4. Safely cut off and terminate wiring abandoned and removed to leave site clean.

B. Reuse of Existing:
   1. Existing concealed conduits in good condition may be reused for installation of new wiring where available.
   2. Existing undamaged, properly supported surface conduits may be reused where surface conduits are called for, if the installation meets all workmanship requirements of the Specifications.
   3. Where new wiring is added or existing wiring disturbed in existing branch circuit raceways, existing wires replaced with new.

C. Salvage and Disposal:
   1. Removed materials, not containing hazardous waste, not scheduled for reuse shall become the property of the Contractor for removal from the site, except for those items specifically indicated on the Demolition Drawings for salvage or reuse.
   2. Materials containing, or possibly containing, hazardous waste identified for removal and disposal by the Owner's Hazardous Waste Contractor.
   3. Neatly store salvaged items at one location at the site where directed by the Owner's Representative.
   4. Salvage properly operating circuit breakers from panels scheduled for removal and use to replace faulty or inadequate breakers in existing panels scheduled to remain.

3.11 WIRING IN PRECAST CONSTRUCTION

A. Coordinate installation of electrical conduit, boxes, fittings, anchors, and miscellaneous items concealed in precast concrete assemblies with the General Contractor.

B. Where electrical items are required to be installed in concrete assemblies precast off-site, it will be the Electrical Contractor's responsibility to place the electrical items necessary in the concrete at the off-site locations or pay for the General Contractor to make arrangements for the installation of these items in the precast assemblies. Electrical Contractor held responsible for the proper placement and locations of electrical items at the off-site location.

3.12 COMPLETION AND TESTING

A. General:
   1. Comply with Division 01, General Requirements.

B. Upon completion, test systems to show that installed equipment operates as designed and specified, free of faults and unintentional grounds.
   1. Schedule system tests so that several occur on the same day.
   2. Coordinate testing schedule with construction phasing.
   3. Conduct tests in the presence of the Architect or its representative.
   4. Notify Architect of tests 48 hours in advance.

C. Engage a journeyman electrician with required tools to conduct equipment tests. Arrange to have the equipment factory representative present for those tests where the manufacturer's warranty could be impacted by the absence of a factory representative.

D. Perform tests per the requirements of each of the following systems:
   1. Low Voltage Distribution System.
   2. Emergency Power System.
   3. Lighting System.
   4. Lighting Control System.

E. Provide a written record of performance tests and submit with operation and maintenance data.

END OF SECTION 26 0500

SECTION 26 0519- LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Conductors - 600V
   2. Power Limited Wiring
   3. MC Branch Circuit Cable
   4. Connectors - 600V and Below

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 REFERENCED STANDARDS

A. ASTM: American Society for Testing and Materials:
   1. ASTM B 3 Soft or Annealed Copper Wire.
   2. ASTM B 8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   3. ASTM B 33 Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. ICEA: Insulated Cable Engineers Association:
   1. S-95-658 Non-shielded 0-2 kV Cables.

C. IEEE: Institute of Electrical and Electronic Engineers:
   1. IEEE 383 Type Test of Class IE Electric Cables, Field Splices, and Connections.

D. UL: Underwriters Laboratories:
   1. UL 44 Rubber-Insulated Wires and Cables.
   2. UL 83 Thermoplastic-Insulated Wires and Cables.
   3. UL 1277 Type TC Power and Control Tray Cable.

1.4 SUBMITTALS

A. Submit product data for the following materials:
   1. Single conductor 600V power and control conductors.

B. Submittals of the following materials consist only of a listing of the manufacturer's name and the applicable catalog numbers of the items to be utilized:
   1. Connectors
   2. Branch Circuit Conductor Splices.
   3. Splices with Compression Fitting and Heat-Shrinkable Insulator.

C. Submit cable test data per testing requirements of PART 3.

1.5 QUALITY ASSURANCE

A. Copper Conductors: Indicated sizes considered minimum for ampacities and voltage drop requirements.

B. Conductors for special systems as recommended by the equipment manufacturer except as noted.

C. Deliver conductors to the job site in cartons, protective covers, or on reels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Conductors - 600V:
   1. General
   2. Essex
   3. Southwire
   4. Or approved equal.

B. Connectors - 600V and Below:
   1. Burndy
   2. Anderson
   3. Or approved equal.

2.2 CONDUCTORS – 600V

A. Type:
   1. Copper: 12 AWG minimum size unless noted otherwise. 12 AWG and 10 AWG, solid or stranded, 8 AWG or larger, Class B concentric or compressed stranded.
   2. Aluminum: Not allowed.
   3. Conductors with continuous colored jackets are acceptable; refer to color-coding in PART 3.
   4. Conductors with manufacturers no lube continuous jacket coatings are acceptable.

B. Insulation:
   1. THHN/THWN-2 for conductors 6 AWG and smaller.
   2. XHHW-2 for conductors 4 AWG and larger.

C. Thru wiring in fluorescent luminaires rated for 90 degree C minimum.

2.3 POWER LIMITED WIRING

A. Copper: stranded or solid as recommended by the system manufacturer.

B. Insulation appropriate for the system and location used.

2.4 CONNECTORS – 600V AND BELOW

A. Branch Circuit Conductor Splices:
   1. Twist-on wire connectors: 3M Insulated Electrical Spring Connector (312/512), Ideal Industries Wingnut, or Buchanan B-Cap.

B. Cable Splices:
   1. Compression tool applied sleeves, Kearney, Burndy, or equivalent with 600V heat shrink insulation.
   2. Submit proposed splice location to the Engineer for review, except where indicated on the plans.

C. Terminator Lugs for Stranded Wire:
   1. 10 AWG Wire and Smaller: Spade flared; tool applied.
   2. 8 AWG Wire and Larger: Compression tool applied.
   3. Setscrew type terminator lugs furnished as an integral part of distribution equipment, switches and circuit breakers will be acceptable.

PART 3 - EXECUTION

3.1 CONDUCTORS

A. Pulling compounds may be used for pulling conductors. Clean residue from the conductors and raceway entrances after the pull is made.

B. Pulleys or Blocks:
   1. Use for alignment of the conductors when pulling.
   2. Pulling in accordance with manufacturer's specifications regarding pulling tensions, bending radii of the cable, and compounds.

C. Make up and insulate wiring promptly after installation of conductors. Do not pull wire in until bushings are installed, and raceways terminations are completed. Do not pull wire into conduit embedded in concrete until after the concrete poured and forms stripped.

D. Provide a dedicated neutral conductor with each branch circuit, do not use a shared neutral conductor between phases unless specifically requested or directed.

E. For remodel work provide a breaker handle tie as required for the phases sharing the neutral conductor.

3.2 CONNECTORS

A. Terminate control and special systems with a tool applied spade flared lug when terminating at a screw connection.

B. Screw and bolt type connectors made up tight and retightened after an 8-hour period.

C. Apply tool applied compression connectors per manufacturer's recommendations and physically checked for tightness.

3.3 COLOR CODING

A. Color code secondary service, feeders, and branch circuit conductors. Phase color code to be consistent at feeder terminations, A-B-C left-to-right, A-B-C top-to-bottom, or A-B-C front-to-back. Color code is as follows:

120/240V 208Y/120V	Phase	480V 480Y/277V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray*
Green	Ground**	Green
* or white with colored (other than green) tracer		
**Ground for isolated ground receptacles green with yellow tracer.		

B. Use solid color compound or solid color coating for 12 AWG and 10 AWG branch circuit conductors and neutral sizes.

C. Phase conductors 8 AWG and larger color code using one of the following:
1. Solid color compound or solid color coating.
2. Stripes, bands, or hash marks of color specified above.
3. Colored as specified using 3/4-inch wide tape. Apply tape in half overlapping turns for a minimum of three inches for terminal points and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Apply tags to cable stating size and insulation type where cable markings are tape covered.

D. Switch legs, travelers, etc., consistent with the phases to which, connected or a color distinctive from that listed.

E. Color-coding of the flexible wiring system conductors and connectors.

F. For modifications and additions to existing wiring systems, conform color-coding to the existing wiring system.

3.4 FIELD TESTING

A. 600V Rated Conductors: Test for continuity. Conductors 100A and over in meggered after installation and prior to termination. Provide the megger, rated 1,000V DC, and record and maintain the results, in tabular form, clearly identifying each conductor tested.
   1. Replace cables when test value is less than 1 megohms.
   2. Cable test submittal include results, equipment used, and date.

END OF SECTION 26 0519

SECTION 26 0526- GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Ground Conductors
   2. Connectors
   3. Ground Rods

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 QUALITY ASSURANCE

A. Provide complete ground systems as indicated. Include conduit system, switchboard frame and neutral bus, motors, and miscellaneous grounds required.

B. Provide 600V insulated main bonding jumper for utility company connection between ground bus in switchgear lineup and ground termination point or service ground in transformer vault as directed by the utility.

C. Provide an insulated ground conductor in every conduit or raceway containing power conductors.

D. Continue existing system as specified herein and shown on the Drawings.

PART 2 - PRODUCTS

2.1 GROUND CONDUCTORS

A. Green insulated copper for use in conduits, raceways, and enclosures.

B. Bare copper for ground grids and grounding electrode systems.

2.2 CONNECTORS

A. Cast, set screw, or bolted type.

B. Form poured, exothermic welds.

C. Grounding lugs where provided as standard manufacturer's items on equipment.

2.3 GROUND RODS

A. Copper-Bonded steel, 5/8-inch by 10-feet long ground rods. Where ground wells are indicated, provide a 12-inch deep, 8-inch diameter precast concrete well with flush lid for accessibility and inspection of welded connections, RCP Vaults 12R12A with 12R12-t cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Grounding Conductors: Sized in accordance with Article 250, Tables 250.66 and 250.122 of the National Electrical Code.

B. Grounding Conductor Connectors: Make up tight, located for future servicing, and ensure low impedance.

C. Ground the electrical system, the cold-water service, structural steel to the building ground grid.

D. Plug-in Receptacles: Bonded to the boxes, raceways, and grounding conductor.

3.2 UFER GROUND

A. Provide a concrete encased building grounding electrode where shown on the Drawings. Grounding electrodes consist of a minimum of 20-feet of AWG 4 bare copper conductor cast into the bottom 6-inches of an exterior concrete foundation or footing.

3.3 EQUIPMENT

A. Provide separate green insulated equipment ground conductor in non-metallic and flexible electrical raceways.

B. Ground luminaires, panels, controls, motors, disconnect switches, exterior lighting standards, and noncurrent carrying metallic enclosures. Use bonding jumpers, grounding bushings, lugs, buses, etc., for this purpose.

C. Provide grounding bushings on feeder conduit entrances to panels and equipment enclosures and bond bushings to enclosures with minimum 10 AWG conductor. Connect the equipment ground to the building system ground. Use the same size equipment ground conductors as phase conductors, up through 10 AWG.

3.4 GROUND RESISTANCE TEST

A. Accomplish with a ground resistance direct-reading single test meter utilizing the Fall-of-Potential method and two reference electrodes. Perform test prior to interconnection to other grounding systems. Orient the concrete-encased ground electrode to be tested and the two reference electrodes in straight-line spaced 50-feet apart. Drive the two reference electrodes 5-feet deep.

B. Provide test results writing.
   1. Show temperature, humidity, and condition of the soil at the time of the tests.
   2. Where the ground resistance exceeds 5 Ohms, the Engineer will issue additional instructions.

END OF SECTION 26 0526

SECTION 26 0529-HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Hangers
   2. Pipe Straps

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 REFERENCED STANDARDS

A. International Building Code (IBC)

B. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

PART 2 - PRODUCTS

2.1 HANGERS

A. Kindorf B-905-2A Channel, H-119-D washer, C105 strap, minimum 1/2-inch rod with ceiling flange, or approved equal.

2.2 PIPE STRAPS

A. Two-hole galvanized or malleable iron.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide electrical equipment supports.

B. Install vertical support members for equipment, straight and parallel to building walls.

C. Provide independent supports to structural member for electrical fixtures, materials, or equipment installed in or on ceiling, walls, or in void spaces and/or over furred or suspended ceilings.

D. Do not use other trades' fastening devices to support electrical equipment materials or fixtures.

E. Do not use supports and/or fastening devices to support other than one particular item.

F. Support conduits within 18-inches of outlets, boxes, panels, cabinets, and deflections.

G. Provide complete seismic anchorage and bracing for the vertical and lateral restraint of conduit, cable trays, bus ducts, and electrical equipment as required by IBC Chapter 6 and the most recent version of the SMACNA Seismic Restraint Manual for Seismic Hazard Level (SHL) A.

H. Submit shop drawings of bracing systems to the Architect for review and bear the seal of a professional engineer registered in the State the project is located.

3.2 LUMINAIRES

A. Light-Duty Ceiling Systems:
   1. Attach 12-gauge hanger wire from each corner of the luminaire to the structure above.
   2. Positively and securely, attach luminaire within 6-inches of each corner to the suspended ceiling-framing member by mechanical means.

B. Intermediate-Duty Ceiling Systems:
   1. Positively and securely, attach luminaire within 6-inches of each corner to the suspended ceiling-framing member by mechanical means.
   2. Attach 12-gauge hanger wire within 3-inches of each corner of each luminaire.
   3. Connect two 12-gauge slack wires from the luminaire housing to the structure above for luminaires weighing less than 56 pounds.
   4. Support luminaries weighing 56 pounds or more directly from the structure above with approved hangers attached to each corner of the luminaire.

C. Heavy-Duty Ceiling Systems:
   1. Positively and securely attach luminaire within 6 inches of each corner to the suspended ceiling-framing member by mechanical means.
   2. Connect two 12-gauge slack wires from the luminaire housing to the structure above for luminaires weighing less than 56 pounds.
   3. Support luminaries weighing 56 pounds or more directly from the structure above with approved hangers attached to each corner of the luminaire.

END OF SECTION 26 0529

SECTION 26 0533-RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Metallic Conduits
   2. Non-Metallic Conduits
   3. Wireways
   4. Fittings
   5. Metallic Boxes
   6. Non-Metallic Boxes

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

PART 2 - PRODUCTS

2.1 GENERAL

A. Raceways and conduits of specified types for electrical system wiring, except where clearly indicated otherwise.

B. Fittings, boxes, hangers, and appurtenances required for the conduits and raceways.

C. Size raceways and conduits as indicated. Where no size indicated, conduit may be the minimum code permitted size for the quantity of conductors installed, based upon NEC tables for conductors with type THW insulation.

2.2 METALLIC CONDUITS

A. Rigid Metal Conduit (RMC):
   1. Smooth surfaced, heavy wall mild steel tube of uniform thickness and temper reamed and threaded at each end and protected inside and out with galvanizing, sherardizing, or equivalent process.
   2. Comply with NEC Article 344.

B. Intermediate Metallic Conduit (IMC):
   1. Smooth surface, intermediate wall mild steel tube of uniform thickness and temper, reamed and threaded at each end, and protected inside and out with galvanizing, sherardizing, or equivalent process.

2. Comply with NEC Article 342.

C. Electrical Metallic Tubing (EMT):
1. Smooth surface, thin wall mild steel tube of uniform thickness and temper, galvanized or sherardized on the outside, and enameled on the interior.
2. Comply with NEC Article 358.

D. Flexible Conduits (Flex):
1. Flexible Metallic Conduit:
a. Interlocking single strip steel construction, galvanized inside and out after fabrication.
b. Comply with NEC Article 348.
2. Liquid Tight:
a. Similar to flexible metallic conduit, except encased in a liquid tight polyvinylchloride or equivalent outer jacket over the flexible steel core.
b. Comply with NEC Article 350.

2.3 NON-METALLIC CONDUITS

A. Rigid Non-Metallic Conduit:
1. Type II PVC Schedule 40 or 80, suitable for use with 90 degree C rated wire.
2. Conform to UL Standard 65l and carry appropriate UL listing for above and below ground use.
3. Comply with NEC Article 352.

2.4 WIREWAYS

A. Troughs: Steel, painted, square in cross section, preformed knockouts on standard spacing, screw cover.

B. Fittings: Tees, elbows, couplings as required for configuration shown on the Drawings.

2.5 FITTINGS

A. RMC and IMC:
1. Threaded Locknuts: Sealing type where used with NEMA 2, 3, 3R, 4, and 12 enclosures.
2. Threaded Bushings: 1-1/4-inch and larger, insulated, grounding type as required under Section 26 05 26, Grounding and Bonding for Electrical Systems.
3. Threaded Couplings:
a. Standard threaded of the same material and as furnished with conduit supplied.
b. Erickson type couplings may be used where required to complete conduit runs larger than 1-inch.

B. EMT:
1. Connectors:
a. Steel compression ring or steel set screw type for conduit termination, with insulated throat, suitable for conditions used.
b. Use lay-in grounding type bushings where terminating grounding conductors.

2. Couplings: Steel compression ring or steel set screw type, concrete tight.

C. Threadless: RMC and IMC couplings and box connectors may be steel threadless, compression ring or set screw type for use with conduits 1-inch and smaller where installed in poured concrete locations or where limited working space makes threaded fittings impractical.

D. Weatherproof Connectors: Threaded.

E. Expansion Couplings: Equivalent to O.Z. type EX with jumper.

F. Seal-Offs: With filler fiber, compound, and removable cover.

2.6 METALLIC BOXES

A. Flush and Concealed Outlet Boxes: Galvanized stamped steel with screw ears for device ring mounting, knock-out plugs, mounting holes, fixture studs if required, RACO or equivalent.

B. Surface Outlet Boxes: Galvanized stamped steel same as above for use on ceilings; cast steel or aluminum with threaded hubs or bosses for use on walls.

C. Large Boxes:
1. Boxes exceeding 4-11/16-inches when required welded steel construction with screw cover and painted, steel gauge as required by physical size.
2. Manufacturers:
   a. Hoffman
   b. Circle AW
   c. Or equivalent.

D. Systems:
1. Boxes for systems devices as recommended by the systems manufacturer, suitable for the equipment installed.
2. Equip with grounding lugs, brackets, device rings, etc., as required.

2.7 NON-METALLIC BOXES

A. PVC, molded enclosures, threaded hubs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conceal conduits in finished spaces. Concealed conduits run in a direct line with long sweep bends and offsets. Where RMC and IMC embedded is in concrete below grade or in damp locations make watertight by painting the entire male thread with Rustoleum metal primer or equivalent before assembly.

B. Route exposed conduit parallel or at right angles to structural building lines and neatly offset into boxes. Conduits attached directly to building surfaces closely follow the surfaces. Conduit fittings used to saddle under beams. Coordinate drilling or notching of existing beams, trusses on structural members with Architect prior to commencing.

C. Rigidly secure RMC and IMC terminations at boxes, cabinets, and general wiring enclosures with double locknuts and bushings or approved fittings. Screw in conduit and engage at least five threads in hub where conduit boxes with threaded hubs or bosses are used. Use insulating bushings for conduits 1-1/4-inches or larger.

D. Keep conduit and raceways closed with suitable plugs or caps during construction to prevent entrance of dirt, moisture, concrete, or foreign objects. Clean and dry raceways before installation of wire and at the time of acceptance.

E. Pack spaces around conduits with polyethylene backing rods and seal with polyurethane caulking to prevent entrance of moisture where conduits are installed in sleeves or block-outs penetrating moisture barriers.

3.2 CONDUIT

A. RMC:
1. Use in areas for wiring systems.
2. Install where subject to mechanical injury.
3. Install with threaded fittings made up tight.

B. IMC:
1. Use for circuits rated 600V and less where not in contact with earth or fill.
2. Install with threaded fittings made up tight.

C. EMT:
1. Securely support and fasten whether exposed or concealed at intervals of nominally every 8-feet and within 24-inches of each outlet, ell, fitting, panel, etc.
2. Use in other dry protected locations for circuits rated 600V and less.
    a. Exceptions:
        1) Acceptable for use in covered, protected areas, where periodically indirectly exposed to exterior weather conditions.
        2) Use raintight compression fittings where exposed to outdoor conditions.
3. Do not install in areas where exposed to damage, such as vehicular or pedestrian.

D. Flex:
1. Use for connections to vibration producing equipment and where installation flexibility is required with a minimum 12-inches slack connection.
2. Limit flex length to 36-inches for exposed equipment connections and 72-inches in concealed ceiling and wall cavities.
3. Use PVC jacketed flex in wet locations, areas subject to washdown, and exterior locations.

E. PVC:
1. Type II Schedule 40 and 80 PVC may be used underground and in and under interior slabs, poured concrete walls, and where scheduled or noted on the Drawings.
2. Make connections with waterproof solvent cement.

3. Provide RMC at 60 degree and larger bends and where penetrating slabs.

3.3 RACEWAYS

A. Surface metal wireways may be installed at locations to serve control devices where required by a multitude of wiring interconnections or physical layout.

3.4 FITTINGS

A. Assemble continuous and secured metallic raceways and conduits to boxes, panels, etc., with appropriate fittings to maintain electrical continuity. Cut square and reamed smooth conduit joints with fittings drawn up tight.

B. Do not use Crimp-on, tap-on, indenter type, malleable iron, or cast set screw fittings.

3.5 BOXES

A. General:
   1. Outlet Boxes: Code required size to accommodate wires, fittings, and devices.
   2. Provide multi-gang boxes as required to accept devices installed with no more than one device per gang.
   3. Equip metallic boxes with grounding provisions.

B. Size and Type:
   1. Flush wall switch and receptacle outlets used with conduit systems 4-inches square, 1-1/2-inches or deeper, with one or two-gang plaster ring, mounted vertically. Where three or more devices are at one location, use one-piece multiple gang tile box or gang box with suitable device ring.
   2. Wall bracket and ceiling surface mounted luminaire outlets 4-inch octagon 1-1/2-inches deep with 3/8-inch fixture stud where required. Wall bracket outlets have single gang opening where required to accommodate luminaire canopy. Provide larger boxes or extension rings where quantity of wires installed requires more cubic capacity.
   3. Junction boxes installed in accessible ceiling or wall cavities or exposed in utility areas minimum of 4-inches square, 1-1/2 inches deep with appropriately marked blank cover.
   4. Boxes for the special systems suitable for the equipment installed. Coordinate size and type with the system supplier.

C. Pull Boxes:
   1. Provide pull boxes where shown for installation of cable supports or where required to limit the number of bends in conduits to not more than three 90-degree bends.
   2. Use galvanized boxes of code-required size with removable covers installed so that covers will be accessible after work is completed.

D. Installation:
   1. Mount boxes and outlets at nominal centerline heights shown on the drawings.
   2. Adjust heights in concrete masonry unit (CMU) walls to prevent devices or finish plates from spanning masonry joints.

3. Recessed Boxes:
   a. Flush with finished surfaces or not more than 1/8-inch back, level, and plumb.
   b. Long screws with spacers or shims for mounting devices will not be acceptable.
   c. No combustible material exposed to wiring at outlets.
4. Covers for flush mounted boxes in finished spaces extend a minimum of 1/4-inch beyond the box edge to provide a finished appearance. Finish edge of cover to match cover face.
5. Boxes installed attached to a stud in sheet rock walls equipped with opposite side box supports equivalent to Caddy 760. Install drywall screw prior to finish taping. Methods used to attach boxes to studs not to cause projections on the face of the stud to prevent full-length contact of sheet rock to the stud face.

3.6 PULL WIRES

A. Install nylon pull lines in empty conduits larger than 1-inch where routing includes 25-feet or more in length or includes 180 degrees or more in bends.

B. Where conduits requiring pull lines are stubbed out and capped, coil a minimum of 36-inches of pull line and tape at termination of conduit for easy future access. Label pull lines as to conduit starting or terminations point and intended future use.

END OF SECTION 26 0533

SECTION 26 0543-UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The Sections includes:
   1. Precast Concrete Handholes and Boxes
   2. Duct Lines
   3. Spacers
   4. Conduit Expansion/Deflection Fittings

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 03, Concrete

C. Division 26, Electrical

D. Division 31, Earthwork

1.3 REFERENCED STANDARDS

A. References listed below:

1.	AASHTO	American Association of State Highway and Transportation Officials
2.	ACI	American Concrete Institute
3.	ANSI	American National Standards Institute
4.	ASTM	American Society for Testing and Materials
5.	NEC	National Electrical Code
6.	NEMA	National Electrical Manufacturers Association
7.	UL	Underwriters Laboratories

1.4 SUBMITTALS

A. Shop Drawings:
   1. Submit descriptive details of the manufacturers' proposed standard product listings, including:
      a. Precast handholes
      b. Precast handhole accessories, including covers and frames
      c. Precast concrete 28-day compressive strength data
      d. Handhole cement certification
      e. Duct spacers
      f. Ducts and raceways
      g. Conduit expansion/deflection fittings

B. Show drawings for handholes, including:
   1. Design criteria signed by professional structural engineer licensed by the State of Oregon.
   2. Reinforcing steel locations and concrete covers.
   3. Layout of inserts, attachments, and openings.
   4. Locations and types of joints.
   5. Accessories, including covers, frames, and diamond plate doors where applicable.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE HANDHOLES AND BOXES

A. Handholes and Boxes:
   1. Precast concrete, 4,000 psi strength at 28 days, with reinforcing and galvanized checker plate traffic covers designed for AASHTO loading of H-20.
   2. Wall thickness 3-inches minimum.

B. Precast Units:
   1. Conform to ASTM C 478.
   2. Size, plan area and clear height not less than shown on the drawings and have concrete slab bottoms with sumps.

C. Design:
   1. Precast structures shall be designed in accordance with AASHTO Specification for Highway Bridges. Concrete and reinforcing shall be designed in accordance with ACI 318.
   2. Tops and walls of structures designed for AASHTO H-20 highway loading, with 30 percent loading added for impact.
   3. Design walls to withstand soil pressures, taking into consideration the soil to be encountered and ground water level present at the site.
   4. Assume ground water level is at ground surface unless a lower water table is indicated in the boring logs. Design and construct precast handhole pull boxes not to float.

D. Identify structures with manufacturer’s name embedded in, or otherwise permanently attached to, an interior wall face.

E. Covers for handholes and boxes spring-assisted galvanized diamond plate door with locking latch, 3-inch high markings in weld bead, inscribed before galvanizing with the word, ELECTRICAL, COMMUNICATION, or DATA. Identify the covers.

F. Acceptable Manufacturers:
   1. Utility Vault Company.
   2. Hanson.
   3. Renton Concrete Products.
   4. Or equal.

2.2 DUCT LINES

A. Size: Except where otherwise shown on the drawings, ducts and conduits shall not be less than 4-inch trade size.

B. Ducts (Direct Buried):
   1. Rigid Non-Metallic Conduit:
      a. Type II PVC Schedule 40, suitable for use with 90°C rated wire.
      b. Conduit conforms to UL Standard 651 and carry appropriate UL listing for above- and below-ground use.
   2. Rigid Metal Conduit:
      a. UL 6 galvanized rigid steel.
      b. Where metal conduit is shown on the drawings or specified below, conduit has a coating of 20 mil bonded PVC, or coated with bituminous asphaltic compound.

C. Manufactured bends shall be not less than 36-inches in radius for conduits 4-inches in diameter or larger.

2.3 SPACERS

A. Factory-fabricated rigid PVC vertical and horizontal interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum of 3-inches separation between ducts while supporting ducts during concreting or backfilling.

B. Manufacturers:
   1. Carlon
   2. Orangeburg
   3. Or equal.

2.4 CONDUIT EXPANSION/DEFLECTION FITTINGS

A. Conduit expansion/deflection fittings in embedded runs rated for indoor use, outdoor use, buried underground, or embedded in concrete in non-hazardous areas.

B. Allow axial expansion or contraction up to 3/4-inch and angular misalignment of the axes of the coupled runs in any direction to 30 degrees. Inner sleeves maintain constant inside diameter in any position and provide smooth insulated wireway for protection of wire insulation.

C. Watertight flexible neoprene outer jacket and tinned copper flexible braid grounding strap.

D. Use with galvanized rigid steel conduit or PVC Schedule 40 conduit utilizing rigid metal conduit nipples and rigid metal to PVC adapters.

E. Manufacturers:
   1. Crouse-Hinds
   2. O-Z/Gedney
   3. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install on a level bed of well-tamped gravel or crushed stone, well-graded from the 1-inch to 2-inch sieve.
   1. The top of frame and covers shall be flush with the finished surface of pavements, and flush with finished grade in unpaved areas.
   2. Set handholes plumb to limit the depth of standing water to a maximum of 2-inches.

B. Locate underground duct lines and handholes at the approximate locations shown on the drawings with due consideration given to the location of other utilities, grades, and paving.

3.2 TRENCHING

A. Excavate trenches in accordance with Division 31, Earthwork.

B. Work with extreme care near existing utilities to avoid damaging them. Cut the trenches neatly and uniformly.

3.3 DUCT LINE INSTALLATIONS

A. General:
   1. Duct line in accordance with the NEC, as shown on the drawings, and as specified.
   2. Slope duct to drain toward manholes and away from building and equipment entrances. Pitch not less than 4-inches in 100-feet. Curved sections in duct lines consist of long sweep bends with a minimum radius of 5-feet in the horizontal and vertical directions unless noted otherwise. Use of manufactured bends is limited to building entrances and stub-ups to equipment.
   3. Underground conduit stub-ups to equipment inside buildings shall be galvanized rigid steel and shall extend at least 10-feet outside the building foundation. Stub-ups to equipment, mounted on outdoor concrete slabs, shall be galvanized rigid steel and shall extend at least 5-feet from edge of slab. Install insulated grounding bushings on the terminations. Couple the steel conduits to the ducts with suitable adapters and encase with 3-inches of concrete.
   4. Upon completion of the duct bank installation, pull a standard flexible mandrel through each duct. The mandrel shall be at least 12-inches long and shall have a diameter 1/2-inch less than the inside diameter of the duct. After mandrelling, pull a brush with stiff bristles through each duct to remove the loosened particles. Diameter of the brush equal to or slightly larger than the diameter of the duct.
   5. Seal the ducts and conduits at building entrances and at outdoor equipment terminations with a suitable non-hardening compound.

B. Direct Burial Duct and Conduits:
   1. Install direct burial ducts and conduits only where shown on the drawings.
   2. Join and terminate ducts and conduits with fittings recommended by the conduit manufacturer.
   3. Tops of ducts and conduits not less than 24-inches below grade.
   4. Do not kink the ducts or conduits.

5. Place a continuous strip of utility warning tape approximately 12-inches above ducts or conduits before backfilling trenches. Refer to Division 31, Earthwork, for tape description and installation requirements.

END OF SECTION 26 0543

SECTION 26 0545-SEISMIC RESTRAINTS FOR ELECTRICAL RACEWAYS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Seismic Bracing
   2. Channel Type Elements
   3. Bolting Accessories

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 REFERENCED STANDARDS

A. The following are the referenced standards:

1.	SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
2.	AISC	American Institute of Steel Construction
3.	ASTM	American Society for Testing and Materials
4.	AWS	American Welding Society
5.	IBC	International Building Code
6.	ICC	International Code Council
7.	OSHPD	Office of Statewide Health Planning and Development
8.	ASCE 7-16	Minimum Design Loads and Associated Criteria for Buildings and Other Structures

1.4 QUALITY ASSURANCE

A. General Requirements:
   1. Provide seismic restraints for equipment, both supported and suspended, conduits, and cable tray systems.
   2. Bracing of conduits and cable trays in accordance with the provisions set forth in the SMACNA seismic restraint manual and the requirements set in ASCE 7 Section 13.2.
   3. Review and approve structural requirements for restraints, including their attachment to the building structure by a registered structural engineer in the same state as the project.
   4. Attachments to supported or suspended equipment must be coordinated with the equipment manufacturer.

B. Bracing of Conduits:
   1. Provide seismic bracing of conduit as detailed below:
      a. Brace electrical conduits 2-1/2-inch nominal diameter or larger.
      b. Brace conduits located in electrical rooms, boiler rooms, mechanical equipment rooms, and refrigeration mechanical rooms that are 1-1/4-inch nominal diameter and larger.
      c. Exception: Conduits suspended by individual hangers 12-inches or less in length, as measured from the top of the conduit to the bottom of the support where the hanger is attached, need not be braced.

C. Suspended Equipment and Raceways:
   1. Cable Method: The seismic restraint shall consist of a combination of stranded steel aircraft cable with an added nut and neoprene and steel washer.
   2. Cable attachment details, cable size, and the neoprene and steel washers shall be sized by the manufacturer and are to be indicated in the shop drawings.
   3. Provide detailed shop drawings for approval in sufficient time to allow structural attachment work to be incorporated into the normal work sequence.

D. Seismic restraints, including anchors to building structure, designed by a registered professional structural engineer licensed in the state of Oregon. Design includes:
   1. Number, size, capacity, and location of anchors for floor- or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both the unit to the curb and the curb to the structure. For units weighing greater than 2500 pounds, or curbs more than 10 feet long, provide substantiating calculations the curb can accept the prescribed seismic forces.
   2. Number, size, capacity, and location of seismic restraint devices and anchors for vibration-isolation and suspended equipment. Provide calculations, test data, or California OSHPD approval number verifying the horizontal and vertical ratings of the seismic restraint devices.
   3. Number, size, capacity, and location of braces and anchors for suspended raceways, bus ducts, and cable trays on as-built plan drawings.
      a. Select a single seismic restraint system pre-designed to meet the requirements of the latest edition of the IBC such as the 1999 Mason Industries Seismic Restraint Guidelines for Suspended Piping, Ductwork, and Electrical Systems.
      b. Details or designs from separate seismic restraint guidelines are not acceptable. Installation not addressed by the selected system shall be designed, detailed, and submitted alone with the as-built plan drawings.
      c. Maximum seismic loads shall be indicated on drawings at each brace location. Drawings shall bear the stamp and signature of the registered professional structural engineer licensed in the state of Oregon who designed the layout of the braces.

E. Supports, Hangers, and Anchors: Comply with the requirements of Section 26 05 29, Hangers and Supports for Electrical Systems meet the requirements of ASCE 7 Section 13.2 based on the Seismic Design Criteria located on the structural drawings.

1.5 SUBMITTALS

A. Product Data: Submit product data for products specified herein.

B. Shop Drawings:
   1. Submit shop drawings complying with the requirements of the Quality Assurance article of this Section.
   2. Stamp shop drawings by a professional structural engineer licensed in the state of Oregon.
   3. Approve submittals prior to rack fabrication and installation.

C. Calculations:
   1. Submit seismic calculations indicating restraint loadings resulting from the design seismic forces presented in the Quality Assurance article of this Section.
   2. Include anchorage details that include the diameter, embedment, and material grade of the material in which the anchor is placed.
   3. Stamped by a professional structural engineer licensed in the state of Oregon.

D. Certifications:
   1. Submit certification of seismic restraint's and building structural member's capability to safely accept loads resulting from seismic forces calculated in the previous paragraph.
   2. Tests in three planes clearly showing ultimate strength and appropriate safety factors performed by independent laboratories and certified by a professional structural engineer licensed in the state of Oregon or calculations by a professional structural engineer licensed in the state of Oregon are acceptable.

PART 2 - PRODUCTS

2.1 SEISMIC BRACING:

A. Steel fabrication, in accordance with AISC Steel Manual, with structural steel shapes of ASTM A 36 steel.

B. Welding in accordance with AWS D1.1.

C. Design and sizes as required.

D. Fastenings, bracing, and assembly selected by a professional structural engineer licensed in the state of Oregon.

E. Show that the maximum stress in any structural steel member will not exceed 18,000 psi.

2.2 CHANNEL TYPE ELEMENTS

A. 12 gauge formed steel, 1-5/8-inch square prime painted or chromate dip finish. Use spring-in nuts with grooves.

2.3 BOLTING ACCESSORIES

A. Machine bolts with semi-finished nuts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide support assemblies to meet the seismic zone indicated. Equipment shall be braced and anchored to conform to the requirements listed under the Quality Assurance article of this Section.

B. Seismically brace raceways, cable trays, and suspended bus duct to conform to the requirements listed under the Quality Assurance article of this Section.

C. Provide pipeline seismic flexible connectors where piping crosses building earthquake joints. Arrange raceways and connectors for the amount of motion required. Maintain continuity of the grounding system for each of the joints.

D. Do not use powder-actuated inserts.

E. Seismic Restraints:
   1. Attach to structural members of the building, which are capable of withstanding the design load of the seismic restraint.
   2. Ensure load capacity of the structural members is greater than or equal to the capacity of the seismic restraint.

END OF SECTION 26 0545

SECTION 26 0553-IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Labels

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

PART 2 - PRODUCTS

2.1 LABELS

A. Pre-printed:
   1. Permanent material pre-printed with black on white, with adhesive backing.
   2. Manufacturer:
      a. Brady
      b. 3M
      c. Or equal.

B. Engraved Laminated Plastic:
   1. 3-ply laminated plastic, colors indicated herein, with beveled edges, engraved letters, and stainless-steel screw attachment.
   2. Nameplate length to suit engraving.
   3. Adhesive attachment is not acceptable.

C. Clear Plastic Tape:
   1. Black (normal) or red (emergency or standby) 12-point Helvetica medium text, clear adhesive backing, field printed with proper equipment for device labeling.
   2. Manufacturers:
      a. Brother P-Touch
      b. Dyno-tape
      c. Kroy
      d. Or equal.

D. Wire Markers:
   1. White with black numbers, adhesive-backed tape on dispenser roll.
   2. Manufacturers:
      a. Brady
      b. 3M

c. Or equal.

E. Feeder Conduit Marking:
1. Provide one-piece snap-around vinyl feeder conduit markers for feeder conduits.
2. Provide custom label, black letters on orange background indicating destination equipment, 1-1/4-inch-high letters (minimum) – Seton Setmark Pipe Marker Series.
3. Provide additional one-piece snap-around vinyl label, black letters on orange background for voltage designation (i.e., 277/480V, 120/208V).
4. Secure labels to conduits using plastic tie wrap, two per label.

F. Marker Pen: Black permanent marker suitable for writing on metallic surfaces.

PART 3 - EXECUTION

3.1 GENERAL

3.2 SWITCHBOARD, DISTRIBUTION PANELS

A. Provide engraved laminated plastic nameplates for main and feeder protective devices indicating the function, or the load served (e.g., ELEV-5, PANEL 4HA, AHU-5, or SPARE) and the protective device trip rating (i.e., 175A). Text height: 3/8-inch.

B. Provide engraved laminated plastic nameplate for bussed spaces indicating the maximum ampere rating of future breaker, switch, or starter that may be installed (e.g., SPACE (225A)). Text height: 3/8-inch.

C. Provide engraved laminated plastic nameplate on the face of equipment enclosure as follows:
1. Line 1: Equipment identification (e.g., MDP, SDP, or MCC 4H). Text height: 3/4-inch.
2. Line 2: Equipment voltage, phase and wire quantity (e.g., 480Y/277V, 3-Phase, 4W). Text height: 1/2-inch.

D. Provide additional engraved laminated plastic nameplate to indicate upstream source and location of upstream source as follows:
1. Line 1: Upstream source equipment (e.g., FED FROM MDP). Text height: 3/8-inch.
2. Line 2: Location of upstream source (e.g., MAIN ELEC ROOM 102). Text height: 3/8-inch.
3. Confirm final room designations with Architect and Owner prior to procurement of nameplates.

3.3 BRANCH CIRCUIT PANELBOARDS

A. Provide engraved laminated plastic nameplate on the face of each panelboard centered above the door as follows:
1. Line 1:
a. Equipment identification (e.g., PANEL 4HA).
b. Text height: 1/2-inch.

2. Line 2:
   a. Equipment voltage, phase, and wire quantity (e.g., 480Y/277V, 3PH, 4W).
   b. Text height: 3/8-inch.

B. Indicate feeder source, feeder wire size, and feeder breaker or fuse size with plastic tape labels on the inside of the panel door.

C. Provide typewritten panel directories, with protective, clear transparent covers, accurately accounting for every breaker installed including spares.
   1. Each load description includes a room or area designation whether indicated on the Drawings or not.

3.4 EQUIPMENT

A. Provide clear plastic tape label for relays, contactors, time switches, and miscellaneous equipment provided under this Division of work indicating equipment served.

3.5 FEEDER CONDUIT

A. Provide feeder conduit marker for electrical feeders.

B. Provide markers when exiting source equipment and located along the entire conduit length 20-feet on centers in exposed areas, above ceilings, and upon entering or leaving an area or room.

3.6 DEVICES

A. Label each receptacle plate with preprinted clear plastic tape indicating serving panel and circuit number (e.g., PANEL 2PA-5). Clean oils, dirt, and foreign materials from plate prior to label application. Label receptacles connected to a GFCI protected circuit downstream from the protecting device.

3.7 RACEWAYS AND BOXES

A. Label pull boxes and junction boxes for systems with paint or marker pen on box cover identifying system. Where box covers are exposed in finished areas, label inside of cover.

B. Label each end of pull wires left in empty conduits with tags or tape indicating location of other end of wire.

3.8 SYSTEMS

A. Complex control circuits may utilize combination of colors with each conductor identified throughout using wraparound numbers or letters. Use the number or letters shown where the Drawings or operation and maintenance data indicate wiring identification.

3.9 EXISTING EQUIPMENT

A. Provide new nameplates and labels for existing distribution equipment in accordance with panel descriptions shown on the Drawings. Provide new labels for feeder devices where labels are non-existent, incorrect, or confusing on existing distribution panels affected by this work.

B. Equip existing branch circuit panelboards scheduled to remain with new, accurate, typed, circuit directories where circuiting changes are made.

END OF SECTION 26 0553

SECTION 26 0573-OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Studies and Analysis

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 REFERENCES

A.	IEEE 141	Recommended practice for electrical power distribution and coordination of industrial and commercial power systems
B.	IEEE 242	Recommended practice for protection and coordination of industrial and commercial power systems
C.	IEEE 399	Recommended practice for industrial and commercial power system analysis
D.	IEEE 1584	Guide for performing arc-flash hazard calculations
E.	NFPA 70	National Electrical Code, latest addition
F.	NFPA 70E	Standard for Electrical Safety in the Workplace, latest addition

1.4 SUBMITTALS

A. Overcurrent Device Coordination Study

B. Device Setting Recommendations

C. Arc Flash Hazard Analysis and report

D. Arc Flash Equipment Labeling Recommendations

E. Arc Flash Label Example

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Emerson

B. Electrical Systems Analysis

C. Qualified engineers of the switchgear manufacturer.

2.2 STUDIES AND ANALYSIS

A. Overcurrent Device Coordination Study:
   1. Provide a coordination study for the electrical overcurrent devices to assure proper equipment and personnel protection.
   2. Present an organized time-current analysis of each protective device in series from the individual device back to the source. Reflect the operation of each device during normal and abnormal current conditions.
   3. Complete and submit prior to procurement of electrical distribution equipment including: switchboards, panelboards, disconnects and overcurrent protection devices.
   4. Provide pertinent information required by the preparers to complete the study.
   5. Include a system one-line diagram and protective coordination curves.
      a. Determine the required settings of protective devices to assure selective coordination.
      b. Graphically illustrate on log paper that adequate time separation exists between series devices.
      c. Plot the specific time-current characteristics of each protective device so that upstream devices are clearly depicted on one sheet.
      d. Time Current Curves: Develop for both phase and ground protective devices.
      e. Provide the following specific information shown on the coordination curves:
         1) Device identification.
         2) Voltage and current ratio for curves.
         3) 3-phase and 1-phase ANSI damage points for each transformer.
         4) No-damage, melting, and clearing curves for fuses.
         5) Cable damage curve.
         6) Transformer inrush points.
         7) Maximum short circuit cut-off point.
         8) Motor starting locked rotor curves.
         9) Clearly marked short circuit current levels through each protective device and branch.
      f. Develop a table that summarizes the settings selected for the protective devices. Included the following:
         1) Device identification.
         2) Circuit breaker sensor rating, long-time, short-time, instantaneous settings, and time bands.
         3) Fuse rating and type.
         4) Ground fault pickup and time delay.

5) Provide characteristic time-current curves for each adjustable overcurrent protective device showing pickup settings, time delay bands, and device operating times. Include trip adjustment time dials and available settings corresponding to each characteristic time-current curve.

B. Arc Flash Hazard Analysis:
1. Provide an Arc Flash Hazard Study per the requirements set forth in NFPA 70E. The arc flash hazard analysis performed according to the IEEE 1584 equations that are presented in NFPA70E.
2. Use study to determine:
   a. Arc flash incident energies.
   b. Arc flash boundaries.
   c. Shock hazard boundaries.
   d. Personal protective equipment (PPE) for energized electrical equipment.
3. Provide the following information for each system mode of operation and documented. The study includes:
   a. Equipment name and voltage.
   b. Equipment device name and ANSI function
   c. Equipment type
   d. Equipment arc gap
   e. Bolted and estimated arcing fault current at the fault point (equipment) in symmetrical amperes. The estimated arcing current should be based on the arcing current equations used.
   f. Trip time, opening time, and total clearing time (total Arc time) of the protective device.
   g. Worst-case arc flash boundary for each bus/equipment in the model.
   h. Worst-case arc flash hazard incident energy in cal/cm2 for each bus/equipment in the model.
   i. Worst-case personal protective equipment (PPE) for each bus/equipment in the model.
   j. Indicate Danger/Hazardous areas where incident energy is greater than 40 cal/cm2 and provide recommendations to reduced arc flash energy levels for these areas.
   k. Flag results where 85 percent arcing current provided worst-case results.
4. Arc flash study report format:
   a. Introduction
   b. Methodology
   c. Backup Information
   d. Key Assumptions
   e. IEEE 1584-2002 Considerations
   f. Arc flash reduction options: Overcurrent protective device changes.
   g. Explanation of data in arc flash hazard report tables.
   h. NFPA 70E Information.
      1) Shock hazards with covers removed.
      2) Shock hazard approach boundaries:
         a) Limited Approach Boundary
         b) Restricted Approach Boundary
         c) Prohibited Approach Boundary
      3) Arc Flash Hazard Boundaries
   i. Results of arc flash hazard analysis for high voltage, medium voltage, and low voltage systems, including:
      1) Working Distances

2) Energy Levels
3) PPE Requirements
4) Recommendations to reduce arc flash hazard energy and exposure.

j. Arc Flash Hazard Report
k. Electronic File

5. Provide labels for the project.

PART 3 - EXECUTION

3.1 SETTINGS AND ADJUSTMENT

A. Set and adjust breakers in the distribution system per the recommendations of the coordination study and settings table.

B. Provide protective covers and locking devices on breakers to secure settings from accidental changes.

3.2 ARC FLASH WARNING LABELS

A. Provide a 3-1/2-inch by 5-inch thermal transfer type label of high adhesion polyester for each work location analyzed.

B. Labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the Owner and after any system changes, upgrades, or modifications have been incorporated in the system.

C. The label includes the following information, at a minimum:
1. Location Designation
2. Nominal Voltage
3. Flash Protection Boundary
4. Hazard Risk Category
5. Incident Energy
6. Working Distance
7. Engineering Report Number, Revision Number, and Issue Date

D. Machine printed labels with no field markings.

E. One arc flash label provided for each, unit substation primary and secondary side, switchboard, switchgear section, motor control center, panelboard, and busway.

3.3 ARC FLASH TRAINING

A. Train the Owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Training certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) of equivalent.

END OF SECTION 26 0573

SECTION 26 0580-ELECTRICAL TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Testing Equipment

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 TESTING CRITERIA

A. General:
   1. Perform field tests and operational checks to assure that all electrical equipment, both contractor and Owner supplied, is operational within industry and manufacturer's tolerances, and is installed in accordance with design specifications.
   2. The tests and operational check shall determine the suitability for energization.
   3. Schedule tests and give a minimum of one week's advance notice of time and date to the Architect and Owner for any major systems tests specified in this Section.
   4. The testing company shall provide the equipment and technical personnel to perform all tests and inspections. At Contractors expense, furnish any personnel necessary to assist in the testing and inspection.
   5. When tests and inspections are complete, attach a label to the devices tested. Provide on the label, the name of the testing company, date of tests, and initials of the Engineer who performed the tests.

B. Responsibilities:
   1. Clean the equipment, torque down accessible bolts according to the equipment manufacturer's instructions; perform routine insulation resistance tests on branch and feeder circuits, continuity checks on branch and control wiring, and rotation tests for distribution and utilization equipment.
   2. Furnish a complete set of current plans and specifications to the testing company prior to commencement of testing. At each test site, provide test control power necessary to perform the tests specified. Consult the test organization as to the specific power requirements. Notify the testing organization when the equipment and systems are ready for their inspections and testing. After review by the testing engineer, correct deficiencies noted by the testing company.

3. Responsible for having the manufacturer of each equipment and/or system provide factory trained representatives(s) that will perform required functional testing, checkout, and repairs in order to pronounce the equipment and/or systems meet the requirements of these specifications and drawings, and it is ready for startup testing and commissioning by the testing organization as specified hereafter.
4. Furnish settings of protective devices by the Engineer, in conjunction with Utility.
5. Testing organization to notify Engineer prior to the commencement of testing. The testing organization, set, and adjust the protective devices and associated auxiliary timing devices in accordance with the values furnished by the Engineer. The testing organization maintains a written record of tests and, upon completion of the test, include them in a final report. Detail deficiencies in the system material, workmanship, or design.

C. Implementation:
1. Safety practices comply with applicable state and local safety orders, as well as with the Occupational Safety and Health Act (OSHA). Compliance with the National Fire Protection Association (NFPA) standard NFPA 70E, and the Accident Prevention Manual for Industrial Operations of the National Safety Council.
2. Tests, other than phase rotation and operational tests, only performed on apparatus that is deenergized. The testing company's lead test engineer for the project designated safety representative and supervise testing observations and safety requirements. Do not proceed with Word until determined that it is safe to do so.
3. Power Circuits: Conductors shorted to ground by a hotline grounding device approved for the purpose. Provide warning signs and protective barriers as necessary to conduct the tests safely.

D. Reports:
1. General: Provide full documentation of tests in the form of a report.
2. Test report includes the following sections:
   a. Scope of Testing
   b. Equipment Tested
   c. Description of Test
   d. Test Results
   e. Conclusions and Recommendations
   f. Appendix, including Test Forms
3. Record each piece of equipment on a data sheet listing the condition of the equipment as found and as left. Include recommendations for necessary repair and/or replacement parts. Indicate on data sheets the name of the engineer who tested the equipment and the date of the test completion.
4. Submit record copies of the completed test report no more than 30 days after completion of the testing and inspection.

1.4 REFERENCES

A. The testing and inspection comply with applicable sections of the applicable codes and standards listed in Section 26 0500, Common Work Results of Electrical of the project specifications.

B. The inspection and testing comply with the project plans and specifications, as well as with the manufacturer's drawings, instruction manuals, and other applicable data that may be provided by the Engineer, for the apparatus tested.

1.5 QUALIFICATIONS

A. Testing Organization:
   1. Independent division of the manufacturer of the assembled products being tested. If an outside testing organization is utilized, a representative of the manufacturer under contract by the testing company. Be present during testing to ensure the testing is performed properly and deficiencies discovered are promptly corrected.
   2. Full-Service Company that employs factory trained test engineers capable of troubleshooting, as well as identifying power equipment problems.
   3. Perform Work outlined under the full time, onsite supervision of a graduate engineer with a minimum of 5 years of field-testing experience.
   4. Upon request, submit proof of its qualifications.

PART 2 - PRODUCTS

2.1 TESTING EQUIPMENT

A. Testing agency to have calibration program, which maintains applicable test instrumentation within rated accuracy. Traceable accuracy to the National Bureau of Standards in an unbroken chain. Calibrate instruments calibrated in accordance with the following frequency schedule:
   1. Field Instruments: 6 months maximum.
   2. Laboratory Instruments: 12 months.
   3. Leased Specialty Equipment: 12 months (where accuracy is guaranteed by lessor). Dated calibration labels visible on test equipment.

PART 3 - EXECUTION

3.1 EQUIPMENT TO BE TESTED

A. Section 26 0519, Low Voltage Electrical Power Conductors and Cables:
   1. For circuits rated 400A or higher perform tests listed in the NETA 2017 Acceptance Testing Specifications for Low-Voltage Cables, Section 7.3.2.

B. Section 26 0526, Grounding and Bonding for Electrical Systems:
   1. Perform tests listed in the NETA 2017 Acceptance Testing Specifications for Grounding Systems, Section 7.13.

C. Section 26 2413, Switchboards:
   1. Switchboards: Perform tests listed in the NETA 2017 Acceptance Testing Specifications for Switchgear and Switchboard Assemblies, Section 7.1.
   2. Circuit Breakers: Perform tests listed in the NETA 2017 Acceptance Testing Specifications for Low-Voltage Circuit Breakers, Section 7.6.1.1.

D. Section 26 2416, Panelboards:
   1. Panelboards: Perform tests listed in the NETA 2017 Acceptance Testing Specifications for Switchgear and Switchboard Assemblies, Section 7.1. Only those tests applicable to panelboards need be performed, no electrical tests of the circuit breakers need to be performed.

END OF SECTION 26 0580

SECTION 26 0961-PRODUCTION VENUE LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results: Furnish and install a complete package of Lighting Control equipment for the General and Production Lighting at the Stage.

B. Related Requirements: Drawings and general provisions of the Contract, including General and Special Conditions and other Division-01 General Requirement sections, apply to the work in this section.

1.2 PRICES AND PAYMENT PROCEDURES

A. Allowances: There are no allowance items in this section.

B. Unit Prices: There are no unit price requirements in this section.

1.3 SUBSTITUTIONS:

A. As required under Division 1, except where additional requirements are listed in this and other individual Sections referenced herein.

B. All bids shall be submitted based exactly on the contents and brand/models as specified on the 'TL' series drawings. No product or device may be substituted without written authorization from the Theater/Assembly Space Consultant. TELEPHONE REQUESTS FOR APPROVAL WILL NOT BE ALLOWED. Only properly completed and signed CSI Substitution Request Forms with full technical catalog data sheets will be considered.

C. Pre-bid approval of substitute product manufacturers does not relieve the contractor and/or the product manufacturer from compliance with the functional and operational requirements of the Specifications. All products will be carefully evaluated during the submittal review process. If, at that time, any pre-bid approved substitute is found to be unsatisfactory and not in compliance, the contractor then must re-submit and supply the specified product(s) without additional costs to the Owner and/or delay to project.

D. If a manufacturer is listed in this section of the Specification as an approved equivalent, but no specific product model is listed, then the Contractor must submit complete factory technical data sheets and a Bill of Materials of the factory's interpretation of equivalent product, along with their CSI Substitution Request. Such submittal shall be handled in review as a pre-bid substitution request.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Mixing of Manufacturers: All products described in this Section of the Specifications shall originate from a common manufacturer, or shall be components from multiple manufacturers which are integrated through factory engineering by a single manufacturer.

B. Provision, installation, and connection of line and load side electrical conduit and wiring for Lighting Control equipment shall be performed under Division 26.

C. Provision, installation and connection of all Control wiring and conduit shall be performed under Division 26.

D. Provision and installation of all raceways, disconnect and overcurrent means shall be performed under Division 26.

E. Receiving, uncrating and installation of all lighting control equipment shall be performed under Division 26.

F. Some Stage Lighting Distribution Devices under Section 26 09 62 may contain control devices specified in this section. Refer to Schedules and Diagrams on 'TL' series Drawings for identification of specific devices.

G. Project Meetings: Refer to Division 01 requirements.

H. Preconstruction Evaluation: Refer to Division 01 requirements.

I. Construction Documentation: Refer to Division 01 requirements.

J. Special Administrative Requirements: Refer to Division 01 requirements.

1.5 SUBMITTAL REQUIREMENTS

A. Submittals for Review: Provide Manufacturer's Data / Specification Sheets and Bill of Materials cross-referenced to 'TL' drawing Control ID tags.

B. The submittals shall include catalog data sheets with the particular product item called out by red arrow. Submittals shall include factory dimensional and installation drawings. Submittals shall show all components of the entire system, even if components are defined as future or deferred or supplied by a different manufacturer but their presence as part of the total lighting control system affects or is affected by the equipment of the primary manufacturer specified herein. Submittals shall indicate which status is applicable for such items.

C. Submittals shall use the unique equipment ID numbers in pentagon tags, identical to the drawings and schedules.

D. Shop Drawings: Indicate all major system components by manufacturer's catalog number. Provide catalog cuts and operational and technical specifications for all major system components. Provide detailed fabrication drawings for all custom fabricated equipment.

E. Samples: Refer to Control Device Schedule on 'TL' series drawings for any specific sample requirements.

F. Submittal documentation shall indicate by a "dashed" condition and tabular listing all deferred devices or equipment. Submittals shall show all components of the entire system, even if components are defined as deferred, furnished by others or future.

G. The Contractor shall bear the responsibility to ensure that the submittals are integrated regardless of the distribution of product among manufacturers. This is particularly true in terms of the lighting control system interconnect diagram.

H. The consultant shall review the submittals one time. If submittal review due to manufacturer's errors or improper submission becomes excessive, the Contractor shall reimburse the Consultant for all excess hours at the Consultant's principal hourly rate.

I. Manufacturer of lighting controls shall incorporate submittal documents for distribution devices of Section 26 09 62.

J. The Contractor, and the manufacturers whose products are selected by the Contractor, shall provide a fully functional system documented in detail in the submittals. If the Architect or Theater Consultant does not discover missing or conflicting elements in the submittals that are in conflict with the contract documents, the Contractor and the manufacturers are still required to comply with the contract documents.

K. System drawings portion of submittals shall be formatted to be completely legible without visual aids or enlargement, at an 11 x 17 plot size sheet, and shall be submitted at no smaller size for review.

L. Provide above items in electronic form. Low resolution scan of a 1st generation physical plot is not acceptable.

1.6 REFERENCES

A. Abbreviations and Acronyms: Refer to 'TL' series drawings for any special definitions related to this work

B. Definitions: Refer to 'TL' series drawings for any special definitions related to this work

C. Reference Standards:
   1. The following listed codes, standards, and regulations refer to the latest current edition and are to be considered a part of this Section: ASTM, AISC, NEC, NESC, NEMA, NFPA, UL, IEEE, ANSI, USITT, ESTA, OSHA, and OSSC.
   2. All equipment where applicable standards have been established shall be listed and labeled by Underwriter's Laboratories or other locally approved testing agency. All Lighting Instruments and Electrical Accessories shall be UL listed and labeled for use as theatrical lighting.
   3. Contractor is responsible for insuring compliance with all applicable building, product, and installation codes (including but not limited to the IBC and NEC) that are in effect at the time of the installation. Corrections to any product, assembly or

work performed under this contract to obtain code compliance shall be at contractor's expense.

4. Custom assemblies shall meet all applicable codes and where local jurisdictions require shall be inspected and approved by the local code authority at the Division 26 contractor's expense.
5. Lighting control equipment shall fully utilize, and control protocols and associated wiring shall conform, to the latest adopted version of the following ANSI standards:
   a. ANSI E1.11 DMX
   b. ANSI E1.20 Remote Device Management (RDM)
   c. ANSI E1.17 Architecture for Control Networks (ACN)
   d. ANSI E1.31 Streaming DMX on ACN
6. Custom field assemblies shall meet all applicable codes and where local jurisdictions require shall be inspected and approved by the local code authority at Division 26 installer’s expense.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. All products described in this Section of the Specifications shall originate from a common Approved Manufacturer or shall be components as listed herein from other manufacturers which are integrated through factory engineering by a single Approved Manufacturer.
   1. Approved Manufacturers:
      a. Basis of Design is Electronic Theatre Controls (ETC)
      b. Strand Lighting (Strand)
   2. Selected devices manufactured by Pathway Connectivity & SSRC as specified herein shall be acceptable only to supplement the offerings of the Approved Manufactures listed above.

B. The Lighting Control Equipment shown on the ‘TL’ Series Drawings are based on the products of one Approved Manufacturer: Electronic Theatre Controls (ETC).
   1. The lighting control wiring topology shown on the ‘TL’ Series Drawings is based on ETC products. The Contractor shall confirm the lighting control wiring topology and cable types of any other Approved Manufacturer, prior to bid, and shall include such adjustments in his bid. The contractor shall maintain an accurate as-built wiring diagram of final system topology and cable types.
   2. Since the ‘TL’ Series Drawings list the exact model numbers and functions of the Lighting Control products of ETC, these specifications shall not include a detailed component description. The products listed on the drawings and schedules shall define the functions and specification requirements. It is the responsibility of the Contractor to ensure that the selected manufacturer makes themselves fully informed as to the performance, inter-equipment functionality and construction attributes of the listed product, in the event that the selected Approved Manufacturer is other than ETC.

C. Other manufacturers may submit for approval prior to the bid date in accordance with subparts 1.3 A. through 1.3 D. above.

2.2 LIGHTING CONTROL BUTTON STATIONS

A. General
1. The control station shall be a remote station on a lighting control network that can recall presets, provide direct zone control, recall presets and provide room combine actions for a control system.
2. The station shall consist of a dual function (control/ record) push-button with an integral bi-color backlight for each corresponding button and fader.
3. The system shall support up to sixteen independent stations

B. Mechanical
1. Control stations shall operate using one, two, four, six or eight buttons. A four button with fader station shall also be available.
2. All button stations shall be available with cream, black or white decorator style faceplates.
    a. Manufacturer's standard colors shall conform to the RAL CLASSIC Standard.
3. Stations shall have bi-color backlights for each button and fader
    a. Indicators shall utilize a blue backlight for active status
    b. Indicators shall utilize amber for inactive to assist in locating stations in dark environments. Stations that do not provide a lit inactive or deactivated state shall not be allowed
    c. Stations shall support an off backlight state of inactive status when required.
4. All faceplates shall be designed for flush or surface mounting and have no visible means of attachment
5. Station faceplates shall be constructed of ABS plastic and designed based on a standard decorator style faceplate. Station faceplates shall be indelibly marked for each button or fader function.
6. Control station electronics shall mount directly behind the faceplate. The entire assembly shall mount into a single gang back box. Back boxes for flush mounted stations shall be industry standard back boxes. The manufacturer shall supply back boxes for surface mounted stations.

C. Electrical
1. Control station wiring shall be control wiring utilizing low-voltage, Class II unshielded twisted pair, type Belden 8471 or equivalent, and one #14 ESD drain wire (when not installed in grounded metal conduit).
2. The station shall operate on class 2 voltage provided by the control system via the lighting control network.
3. Station wiring must be topology free. It may be point-to-point, bus, loop, home run or any combination of these.
4. Wiring termination connectors shall be provided with all stations.
5. Control stations shall be UL/ cUL listed and CE marked and meet WEE Compliance

D. Station Addressing
1. Station addressing shall be via two 16 position rotary dials and will be set by installers or factory personnel. Station addressing shall require only a space assignment and a device ID assignment.
2. Multiple stations may have overlapping control of presets and zones

E. Approved Products
1. Basis of Design is ETC – Echo Inspire Station, 8 button (#E1008)

2. Strand Vision.net

2.3 LIGHTING SYSTEM AUXILIARY RACK

A. Provide an EIA 19-inch equipment rack with multiple networking and lighting control devices for use with the lighting control system. This device shall be appropriately listed and labeled as an assembly by a UL approved shop.

B. The Lighting System Auxiliary Rack shall contain the following components:
1. Touchscreen Lighting Controller (See 2.4 below)
2. POE Lighting Network Switches as required to manage SACN data between all network-based lighting system components, certified for use with the selected Approved Manufacturer's proprietary network protocols.
3. Lighting Network Cable Brush Panels
4. Lighting Network Patch Bay
5. Rack mount DMX / RDM Lighting Network Gateways. (See 2.5 below)
6. Rackmount UPS
7. Custom Label Plates
8. Vented Locking Door
9. Power outlet strip with feed cord & plug (not less than four NEMA 5-15R outlets) to be plugged into output of UPS as source. Run vertical at cabinet rear.
10. Plywood backplane or modular metal attachment ribs - finished black.
11. Any other components called out as mounted in the Lighting System Auxiliary Rack as identified on the 'TL' Series Drawings.

C. Approved Products:
1. Lighting System Auxiliary Rack Enclosure:
   a. Middle Atlantic "DWR series".
2. Lighting System Auxiliary Rack Assembly & Components:
   a. Basis of Design is ETC.
   b. Strand Lighting

2.4 LIGHTING CONTROLLER – TOUCHSCREEN

A. General
1. The Touchscreen protocols station shall provide control of up to 512 networked addresses or up to 512 local DMX addresses on a maximum of eighty (80) control zones. Addresses may be distributed using DMX512-A or via sACN or Art-Net Ethernet-based lighting
2. The Touchscreen station shall operate using graphic buttons, faders and other images on at least 7 user programmable control pages
3. Touchscreen stations shall support default and fully graphical control pages

B. Mechanical
1. Touchscreen stations shall consist of a seven inch, backlit liquid crystal display (LCD) with a minimum resolution of 800 by 400 pixels with a capacitive multi-touch interface
2. Touchscreen bezels shall be constructed of cast zinc finished in a fine texture powder coat.

a. Touchscreen shall be available in four standard colors
   1) Cream (RAL 9001)
   2) Gray (RAL 7001)
   3) Black (RAL 9004)
   4) Signal White (RAL 9003)
b. The bezel shall have no visible means of attachment

3. Touchscreen station shall be rack mounted in Aux Rack (see 2.3 above)

C. Electrical
1. The Touchscreen shall have an RJ45 Ethernet port for connection to a lighting system and for Power over Ethernet (PoE)

D. Approved Products:
1. Basis of Design is the ETC #ETS “EchoTouch Controller Mk2”, with #ETS-RM Rack Mount Kit.
2. Strand Vision.Net Touchscreen & Vision.net to DMX interface

2.5 DMX / RDM LIGHTING NETWORK GATEWAYS

A. Provide types and quantities as identified on the ‘TL’ Series Drawings.

B. Each gateway shall have one or more ports, which convert SACN data to a pre-defined range of 512 DMX addresses.
1. Each port shall be suitable for programmable configuration as either a DMX input or DMX output as identified on the TL Series Drawings.
2. The range of DMX addresses each port transmits shall be selectable via software interface.
3. Each port shall have the ability to pass RDM data.

C. Gateways shall be fabricated as flush mount, surface mount, pipe mount, portable, din rail mount, or rack mount. Gateways shall be configured for power over ethernet for operating current and voltage, except for rack mount gateways which shall be externally powered.

D. Din rail mount & Rack mount gateway ports shall each be provided with terminal block connectors, unless otherwise identified on the ‘TL’ Series Drawings.

E. 5 pin XLR ‘turnaround’ cables shall be acceptable as required to present the proper connector type.

F. Approved Products
1. Basis of Design is the ETC “Response Mk2 4-Port Gateway”, with #N3GA-RM Rack Mount Kit
2. Strand DMX 512 Networking Nodes

2.6 REMOTE PLUG IN STATIONS

A. Provide types and quantities as identified on the ‘TL’ Series Drawings.

B. Device Label Requirements

1. Refer to Control Device Schedule and Distribution Device Schedule on 'TL' Series Drawings.

C. Remote Plug In Stations may be mounted integral to Stage Power Enclosures, specified in section 26 09 62.

D. DMX Input and Output Receptacle Stations.
1. DMX input receptacle stations shall contain a 5-pin, flush mounted XLR male receptacle on the front side. The rear side shall have a circuit board and an RJ-45 female connector or Category-5 rated punch-down block prewired to front side receptacle. Provide with crimping pin-out instructions.
2. Provide permanent labeling at all DMX input receptacles; "DMX #X IN", where "X" stands for the DMX universe number.
3. DMX output receptacle stations shall contain a 5-pin, flush mounted XLR female receptacle on the front side. The rear side shall have a circuit board and an RJ-45 female connector or Category-5 rated punch-down block prewired to front side receptacle. Provide with crimping pin-out instructions.
4. Provide permanent labeling at all DMX output receptacles: "DMX #Y OUT", where "Y" stands for the DMX universe number.
5. DMX receptacles shall have a black anodized aluminum plate.
6. DMX receptacles mounted in other control or distribution devices shall be panel mount type and shall be constructed similar to stand-alone units.
7. Provide plug-type DMX signal terminators, as scheduled, using matching 5 pin male XLR device and 120 ohm resistance in accordance with ESTA/USITT standards, where required in multi-device assemblies.

E. Lighting Network Receptacle Stations.
1. Provide RJ-45 Ethernet receptacles for lighting control system, integral to submersible Stage Power Enclosure, at locations shown on 'TL' Series drawings.
2. All Ethernet receptacles for lighting control shall support Power Over Ethernet (PoE)
3. Do not connect Ethernet receptacles for lighting control system to hubs, routers or switches which are part of the general building Ethernet system unless specifically instructed to do so on the 'TL' Series Drawings.

F. Approved Products
1. Basis of Design is the ETC ECPB Stations
2. Strand remote plug in stations.

2.7 POWER CONTROL RELAY PANEL 'RP1'

A. System Description
1. Relay Panels shall be UL508, UL67, and UL924 Listed, and shall be so labeled when delivered
2. Relay Panels shall consist of a main enclosure with 30 pole breaker subpanel, relay/dimmer sub panel, integral control electronics, and a low voltage subpanel for data terminations and provision for accessory cards
   a. Up to two accessory cards shall be supported per relay panel
3. Refer to 'TL' series drawings for application and interconnection of lighting controls.

4. All relays shall be fully duty rated for no less than 20A continuous current at 120VAC.
5. Refer to 'TL' series drawings for details & quantities.

B. Mechanical
1. The panel shall be constructed of 16-gauge steel. All panel components shall be properly treated and finished in fine-textured, scratch resistant paint
2. Provide relay panels in 120 Volt AC configurations
   a. 120V enclosures shall be 67.5" high by 14.36" wide and 4" deep with a weight not more than 80 pounds
3. The panel shall be capable of being mounted on the surface of a wall or recessed mounted
   a. 120VAC panels shall support mounting between standard wall stud framing (16-inch on center spacing)
4. Choice of panel covers shall be available for surface or recess mount applications. This outer panel shall ship complete with a locking door to limit access to electronics and breakers, breakers
   a. Optional center-pin reject security screws shall be available for all accessible screws
   b. Recess mount doors shall extend 1" beyond all panel edges to hide wall cut-out
5. The unit shall provide interior cover over breaker panel to allow access only to class 2 wiring and prevent direct access to class 1 line voltage components
6. The Relay panel shall support up to twenty-four 20-amp single pole circuits made up of relays or 300W dimmers
   a. Two and three-pole relay circuits shall be supported at decreased density where each pole constitutes one of the available single-pole circuits. Mixing of circuits in any combination shall be supported
   b. Panels that do not support an integral dimmer module shall not be acceptable
7. Relays shall include integral switches for manual control while power is unavailable to the panel such that critical lighting can be set to an on state, without the need for power to the panel
8. Relay output lugs shall accept 6-14AWG copper wire
9. Breaker subpanel may include up to twenty-nine 20-amp single pole, up to fourteen 20 amp double pole, or nine three pole breakers as required in any combination up to capacity
10. Control wiring for DMX, station bus, and Emergency input terminations shall land on removable headers for contractor installation.

C. User Interface
1. The user interface shall contain a graphical display with button pad to include 0-9 number entry, up, down back arrow navigation and enter
2. Test shortcut button shall be available for local activation of preset, sequence and set level overrides
3. The user interface shall have a power status LED indicator (Blue), a DMX status LED indicator (Green), a network status LED indicator (Green) and an LED indicator (red) for errors
4. Interface shall allow the backlight to timeout and shall provide user editable options to shut off backlight completely as well as adjust screen contrast

5. Ethernet interface shall default to automatic IP through link local and DHCP. Upon receiving IP address, the address of the Network Interface Card (NIC) shall display in the about menu. Static address and settings shall also be possible
6. The control interface shall support a USB memory stick interface for uploads of configurations and software updates

D. Functional
1. Panel setup shall be user programmable. The control interface shall provide the following relay setup features (per circuit):
    a. Type (1 pole, 2 pole, or 3 pole)
    b. Name
    c. Circuit Number
    d. DMX address
    e. sACN address
    f. Space Number
    g. Circuit Modes
        1) Normal (priority and HTP based activation and dimming)
        2) Latch-lock
        3) Fluorescent
        4) DALI
    h. On threshold level
    i. Off threshold level
    j. Include in UL924 emergency activation
    k. Allow Manual
2. Relay panels shall support discrete addressing of each relay. Panels that are restricted to use of start address with sequential addressing and cannot assign each 0-10V output control to any internal relay shall not be acceptable
3. The panel shall be capable of switching all relays on or off at once, or in a user-selectable delay per relay using a period of 0.1 to 60 seconds, in 0.1 second increments
4. An Ethernet connection shall provide advanced control of relays over streaming ACN (sACN) and transmit status, control override, and measured energy usage per branch circuit via an internal Web UI or central monitoring interface
    a. Control electronics shall report the following information per branch circuit
        1) Breaker state (On/Off)
        2) Breaker state (Open/Closed)
        3) Current draw (In Amps)
        4) Voltage
        5) Energy usage
    b. Panels that do not report this information shall not be acceptable
5. Built-in Control shall include:
    a. Ability to record up to 16 presets in each space from the control panel, connected control stations, or timed events
    b. Presets shall be programmable by recording current levels (as set by DMX or connected control stations), by entering levels on the control panel directly, manually selecting relay state on each relay or a combination of these methods. From the control panel, stations, or timed events it shall be possible to record values for up to 16 zones per space
    c. Up to 8 spaces in a single rack for total of up to 16 spaces shall be supported per system or system subnet
    d. Indication of an active preset shall be visible on the control panel display

e. One 16-step sequence per space for power up and power down routines
f. The panel shall have a UL924-listed contact input for use in Emergency Lighting systems. The panel shall respond to the contact input by setting included relays to “on”, while setting non-emergency relays “off”. Each relay can be selected for activation upon contact input
g. Upon Data loss the system shall provide options to hold last look infinitely or hold for a configured time period set by the installing technician then fade/switch to the input of the next available priority
h. Control electronics shall respond directly to control stations for zone, preset, and sequence control. Systems that require secondary control systems for this functionality are not acceptable
i. After power loss, electronics shall be capable of holding the system in its previous state until new level data (DMX, architectural presets, sequences and zones, or local overrides) is received to make each relay change state

6. The control of lighting and associated systems via real time and Astronomical clock controls
   a. The relay panel shall allow the activation of presets, sequence, and zone programming of up to 50 time clock events via a built in real and astronomical timeclock
   b. System time events shall be programmable via the control panel.
      1) Time clock events shall be assigned to system day types. Standard day types include: everyday, weekday, weekend, Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday
      2) Time clock events shall be activated based on sunrise, sunset, time of day or periodic event
      3) System shall automatically compensate for regions using a fully configurable daylight saving time
      4) Presets shall be assigned to events at the time clock
   c. The time clock shall support event override
      1) It shall be possible to override the timed event schedule form the face panel of the time clock
   d. The time clock shall support timed event hold
      1) It shall be possible to hold a timed event from the face panel of the processor
      2) Timed event hold shall meet California Title 24 requirements
7. The panel shall receive ESTA DMX512-A control protocol. Addressing shall be set via the user interface button keypad with any relay being patched to any DMX control address
   a. 2,500V of optical isolation shall be provided between the DMX512 inputs and the control electronics as well as between control and power components
   b. The relays shall respond to control changes (DMX or Stations) in less than 25 milliseconds. DMX512 update speed shall be 40Hz
   c. Setting changes shall be able to be made across all, some, or just one selected relay in a single action from the face panel
   d. DMX data loss shall allow for levels/relays to be held for ever or for a specified time before switching to a lower priority source
   e. Initial Panel setup
      1) The relay panel shall automatically detect the type of relay or dimmer installed in each location without need for manual configuration of the physical arrangement.

2) Quick rack setup shall be available to apply address settings across all circuits for rack number, DMX Start Address, sACN universe, and sACN start address.
3) Emergency Setup Menu shall provide optional delays when emergency is activated or deactivated, and option to turn off non-emergency circuits shall be available. Record function shall allow circuits that are turned on to be added to the emergency setting

E. Electrical
1. Relay Panels shall be available to support power input from:
   a. 120/208V three phase 4-wire plus ground
2. Conduit Entry:
   a. Feeders:
      1) Top or top-side (upper 6" of either side)
      2) Bottom or bottom-side 6" of either side
      3) Feeders shall enter through the top or bottom according to the orientation of the enclosure
      4) Feeder entry shall be nearest to the location of the feeder lugs or main breaker
   b. Load:
      1) Load wiring shall enter through the top or bottom of the enclosure
      2) Load wiring shall enter through the top/bottom surface nearest to the breaker sub panel
      3) Load wiring may also enter through left and/or right side provided a low voltage chase is not required through the same area. If class 2 chase is required, a field installable barrier panel shall be provided upon request. When installed, the left or right side of the panel, where the barrier has been installed, shall not permit load wiring
   c. Low Voltage:
      1) Top or top-side (upper 6" of either side)
      2) Bottom or bottom-side (bottom 6" of either side)
      3) For low voltage conduit entry at the relay end of the cabinet, conduits shall be located at the outer 3" of the top/bottom panel
      4) Field installed low voltage channel shall be provided separately for installation on the left or right side of the panel to allow class 2 wiring to traverse the panel from top to bottom or bottom to top
3. All relays shall be mechanically latching
4. The relay shall be capable of switching 20A at up to 300V
5. The relay panel shall support a maximum feed size of 200 Amps
6. Relay panels shall support main circuit breaker options:
   a. Main breaker options shall be optional and available for purchase upon request
   b. Main breakers shall be field installable
   c. Main breakers shall be available in 100 and 200 Amps for 120V systems and 150 Amps for 277V systems
   d. Series rated SCCR ratings apply as follows with appropriate main breaker:
      1) 22,000A at 120/240V
   e. Main breakers shall allow the following range of wire sizes:
      1) 3/0 to 300kcmil at 120/208V

F. Relay
1. Each relay shall have a manual override switch with on/off status indication
2. Relays shall be rated for use with:
   a. 16A Electronic Ballast loads @ 120, 240 and 277V
   b. 20A Tungsten loads at 120, 240, and 277V
3. Isolation shall be 4000V RMS
4. Relays shall be latching state
5. Rated Life:
   a. 1,000,000 mechanical activations
   b. 100,000 cycles at full resistive load
   c. 30,000 cycles full motor, inductive, tungsten, and electronic (LED)
   d. Decreasing loading shall increase the rated life of the relay inversely proportional the square of the load
6. Relays shall support reporting of current usage with an accuracy of five percent of the connected load

G. Relay Panel Accessories
1. A low voltage 0-10V dimming option shall provide up to 24 0-10v control outputs that are linked to relay circuits within the panel. Each output shall support up to 400mA of current sink per output
2. A contact input option shall provide 24 dry contact inputs to be linked for direct or group relay control, to activate a preset, or to activate a sequence. Controller software shall allow for normally open maintained, normally closed maintained, or momentary toggle
3. A DALI control option shall provide 24 control loops of broadcast DALI control, with each loop controlling up to 64 DALI devices
4. A RideThru option shall provide short-term power backup of control electronics by automatically engaging when power is lost, and recharging when normal power is present
5. A tamperproof hardware kit shall be available that provides center reject Torx head screws to prevent access to panel interior by unqualified individuals

H. Main Breaker options shall be available as specified
1. The panel shall be convection cooled. Panels that require the use of cooling fans shall not be acceptable
2. The panel shall operate safely in an environment having an ambient temperature between 32ºF (0ºC) and 104ºF (40°C), and humidity between 5-95% non-condensing

I. Approved Products:
1. Basis of Design is the ETC ECHO #ERP-24R1-29B1-ML3P “Mains Feed” Relay Panel.
2. Strand Contact series

2.8 DMX INTERFACE FOR EMERGENCY LIGHTING

A. Provide types and quantities as identified on the TL Series Drawings.

B. Shall interface between LED lighting fixtures, which use a DMX signal for dimming and are set to be emergency egress fixtures.

C. Unit shall pass-thru normal DMX source during non-emergency times and shall interrupt normal DMX stream and replace with its own emergency DMX data stream to designated emergency LED fixtures.

D. Refer to 'TL' Series Drawings for specific interconnection requirements.

E. Approved Products
   1. Basis of Design is the ETC #DEBC
   2. Strand Emergency DMX Bypass Switch

2.9 EMERGENCY BYPASS DETECTION

A. Provide types and quantities as identified on the 'TL' Series Drawings.

B. Shall detect the loss of normal power and trigger special-purpose lighting presets.

C. Mechanical
   1. The Enclosure shall be a surface mounted, constructed of 16-gauge, formed steel panels with a removable front cover.
   2. The Emergency Bypass Detection shall include a 3-pole, 10 amp breaker for local over-current protection and simulation of normal power loss.
      a. The enclosure shall have a lockable door to allow limited access to the over-current protection breaker
   3. All components shall be properly treated and finished.
      a. Exterior surfaces shall be finished in fine textured, scratch-resistant, powder coat paint
   4. The Emergency Bypass Detection enclosure shall provide discrete high and low voltage wiring compartments with voltage barrier.

D. Electrical
   1. Emergency Bypass Detection enclosures shall support 100 to 277 volt configurations
      a. Enclosures shall be field configurable for single-phase, bi-phase, and three-phase operation without the need for additional components.
   2. Phase Loss Detection circuitry shall provide 0.5 second delay to prevent nuisance tripping
   3. The Emergency Bypass Detection shall provide an integrated circuit breaker for over-current protection and simulation of normal power loss
   4. The Emergency bypass detection shall support isolated outputs for connection to multiple dimming products simultaneously
      a. Three isolated contacts shall be provided
      b. Each contact shall support connection of up to four dimming products.
   5. The Emergency Bypass Detection shall be completely pre-wired by the manufacturer. The contractor shall provide input feed and control wiring.
   6. All control wire connections shall be terminated via factory provided connectors.
      a. Factory provided connector shall support 12 to 22-gauge wiring
      b. Emergency lighting input shall support load shedding
   7. The Bypass Detection shall prove a normally-closed input for interface with fire alarm systems

8. The Bypass Detection shall be UL and cUL Section 924 Listed for interaction with similarly listed dimming and switching panels

E. Thermal
1. Ambient room temperature: 0-40°C / 32-104°F
2. Ambient humidity: 10-90% non-condensing

F. Approved Products
1. Basis of Design is the ETC #EBDK
2. Strand Phase Loss Sensing Panel

2.10 BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH (BCELTS)

A. General
1. The BCELTS shall provide automatic transfer of a single branch circuit from normal to emergency power source, when normal power fails
2. The BCELTS shall transfer a lighting load branch circuit from a dimmer/ relay or secondary control output to a second power source in the event of a loss of power to the primary power source, a normal system failure, or activation of a fire alarm
3. The system shall be listed under ANSI / UL1008 Transfer Switch Equipment and comply with ANSI / NFPA 110 Standard for Emergency and Standby Power Systems, and ANSI / NFPA 70 (NEC), including Article 700, 701 and 702 safety standards. Emergency transfer systems that do not comply with the below stated NEC articles and sections shall not be permitted
4. The BCELTS shall transfer a single circuit at 120V or 277V up to 20 Amperes in capacity

B. Transfer Switch
1. The BCELTS shall be a UL1008 transfer switch listed for Emergency Systems (NEC Articles 700 and 701; UL CCN WPWR)

C. Operation
1. Transfer to alternate emergency supply will occur when normal supply sense voltage drops below 80V when used at 120V or 277V

D. Enclosure
1. The BCELTS shall be mounted in a NEMA 1 interior type enclosure finished in fine- textured epoxy paint

E. Approved Manufacturers and Products:
1. Basis of Design is the ETC #SC1008
2. Strand

PART 3 - EXECUTION

3.1 GENERAL

A. The contractor shall coordinate with all other trades regarding placement and connection of equipment prior to installation of equipment.

B. Before installation work the contractor shall verify that approved shop drawings reflect the actual field requirements. Report any deviation between field conditions and shop drawings to the Architect in writing.

C. Manufacturer shall provide detailed and specific installation instructions to the Contractor for proper installation of the equipment.

D. Contractor shall provide all mounting hardware needed for proper installation of the equipment per manufacturer recommendations and requirements.

E. All deviations from the system design on the Contract Documents must be preceded by an approved RFI submission (from the Contractor) that has been reviewed by the Architect and the Theater Consultant. If deviations are found during a job observation visit or during punchlist site visit, the Theater Consultant and/or Architect may direct the Contractor to re-do the work to comply with the contract documents, at no additional cost to the Owner or Architect's design team, if said deviations are not the result of a directive issued in response to a timely submitted RFI.

3.2 INSTALLATION TEST AND ADJUSTMENTS

A. The lighting control system shall be tested and in complete operating order under terms of this Section of the Specification, as well as any requirements listed in the General Conditions.

B. The contractor shall provide a factory trained technician to test and commission the lighting control system.

C. At the completion of the installation and control wiring terminations, the system shall be energized by the aforementioned trained factory technician. At this time the following tests shall be conducted:
   1. Final Continuity Check and I.D. Verification of all load circuits.
   2. Relay Panel Operation - Each relay shall be tested individually with a minimum 75% load.
   3. Documentation Verification - The contractor, in conjunction with representatives of both the Architect and Manufacturer, shall review the scope of work covered by this Section of the Specifications and, if necessary, create a "punch list" of items requiring correction. All corrections shall be made in a timely manner, to not lengthen the contract period nor interfere with daily activities of using agency.

D. The Contractor shall be responsible for any and all corrections to the system that shall be made by the manufacturer and shall compensate the Theater Consultant for any time that is required to perform or coordinate the performance of services that are the responsibility of

the contractor and or their subcontractors and vendors in the event that the subcontractor or vendors do not respond in a timely and appropriate fashion during the punchlist, closeout, testing, demonstration and warranty periods.

E. After receipt of the punchlist, the Contractor shall perform all work necessary to rectify the items on the punchlist. Once all items have been rectified, the Contractor shall notify the Architect in writing that the work is ready for backcheck of the punchlist. If during the onsite backcheck review, the Architect and/or Theater Consultant observe incomplete or incorrect items necessitating another punchlist and another backcheck, the Contractor shall provide compensation for all return site visits and time required to generate followup reports.

3.3 SYSTEM STARTUP, OWNER'S INSTRUCTIONS & COMMISSIONING

A. Operation Instruction:
   1. Supply instruction to the Owner's operating personnel on operation and care of system for not less than eight hours total. Instruction shall include, but not be limited to, proper general maintenance of the system, replacement procedures for user replaceable parts and operating procedure to obtain maximum usage of system.
   2. Deliver all copies of approved Operations Manual to The Owner's Representative prior to first instruction session, and review it as part of that session.
   3. The training shall take place in the presence of the Owner's Representative or the Owner's Representative's sub-consultant, and shall occur directly after finish of Completion Checkout. If the Owner's Representatives judge that any work inspected fails to conform to the specification, or is not substantially complete at time of Completion Checkout, postpone instruction session until the Owner's Representatives judge the entire Lighting System to conform to specification.

B. Houselight Preset Programming
   1. Contractor shall have an authorized factory technician configure the lighting control system configuration and preset programming in accordance with a Programming schedule prepared by the Theater Consultant. Programming Schedule shall be part of the contract documents and/or shall be confirmed at time of submittal review.
   2. Deviations from the Programming Schedule that have not been pre-approved by the Theater Consultant in advance of system configuration shall be reset to those as specified, unless the deviations are shown to be critical to proper system function.

C. Owner Adaptation Adjustment Period
   1. Contractor shall include allowance for (2) additional visits to adjust system software configuration, to allow for revisions due to adaptation and familiarization by the Owner's staff after occupation of the facility has been obtained, or due to adjustments requested by the Theater Consultant to optimize the original intended functionality.
   2. The (2) additional visits defined herein shall be in addition to any visits mandated by punchlist or backpunch corrections to the published system configuration schedules prepared and submitted by the Theater Consultant.
   3. Time period for these Adaptation Adjustment site visits shall be limited to:
      a. 3 months after Owner has taken beneficial occupancy of the facility, or
      b. 3 months after approval from the Theater Consultant that all related punchlist / backpunch items have been satisfied, or

c. 3 months after Owner has had continuous, normal scheduled use of the facility and the prior two conditions have also been met, or
d. Whichever of the three prior conditions is longer.

3.4 MAINTENANCE

A. Maintenance services
1. One year following date of final acceptance, a factory engineer shall be provided to examine, adjust and repair the equipment included in this section which is found to require warranty work prior to the end of the warranty period. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the Manufacturer. All labor and materials which are required to perform this service shall meet or exceed these specifications and shall not compromise the performance of the equipment in any way.
2. Following this inspection and maintenance service, the Manufacturer shall provide the Owner and Theatre Consultant with a written report itemizing the results of the inspections and the warranty work, which was conducted. The Manufacturer shall also include in this written report recommendations for any corrective actions which the Manufacturer feels should be taken, with respect to the equipment included in this section, but are outside the scope of the warranty agreement.

B. Extra Materials:
1. Deliver stock of maintenance material to the Owner. Furnish the following to match those installed and taken from the same production run, packaged with protective covering for storage and identified with appropriate labels.
a. Two spare relay modules for each type of relay module in the system.
b. Provide one spare faceplate or complete internal components of each type of control device in the system (not including the GCS processor).
c. One spare Ethernet node or complete internal components of each type of node in the system.
d. Two circuit breakers of each size in the system.
e. Provide a package of spare parts for all user serviceable portions of the dimmer and control systems and distribution apparatus.
f. Provide 10% of total quantity of each type of small, replaceable component or part in system as spare parts (minimum of one).
g. Label all spare parts with Manufacturer's part number, designation and description, and location(s) where used.
h. Provide durable, clearly labeled, storage containers for all spare parts, including special static free containers for electronically sensitive parts.

3.5 WARRANTY

A. All major components shall carry a manufacturer’s and/or installer’s warranty, which shall guarantee against defects in materials and workmanship for a minimum period of two years. Refer to Division 01 for the start of the warranty period.

B. Warranty must include all shipping expenses including, but not limited to, return shipping of items which do not meet these specifications.

C. The warranty period shall not start until all punch list items have been rectified.

D. The Contractor shall warrant materials and workmanship of systems and equipment installed as free of defects. The Contractor shall guarantee in writing the repair or replacement within two calendar weeks for any item found defective during the warranty period. Ordinary wear and defects due to improper usage are not included.

E. During the warranty period, all emergency conditions where system failures may be hazardous or may cause severe hardship or cancellation of events and performances shall be responded to within 24 hours.

F. If start of warranty is delayed due to delay in contractor completing the punchlist items, and owner has commenced use of the facility, the Contractor shall provide the same level of service and responsibility defined herein.

3.6 PROJECT CLOSEOUT DOCUMENTS

A. System Drawings and Data Sheets
1. Provide at same size as original submittals, with all record data for as-built conditions.
2. Data sheets shall be keyed to ‘TL’ Series drawings and submittals, similar to original submittal set.

B. Operation Manuals
1. For each equipment item, provide a printed and PDF file version of the current and matching Operation Manual.

C. Parts and Maintenance Manuals
1. For each equipment item, provide a printed and PDF file version of the current and matching Parts and Maintenance Manuals, clearly indicating part and ordering numbers for any and all Owner replaceable components.

D. Field and Factory Service Contact Information
1. Provide the contact information for warranty-based and post-warranty service support, both factory and local contacts at the time of project commissioning.
2. Include instructions as to proper service support contact protocol, indicating under what conditions the Owner should contact the factory, or the local support center.
3. Include the job number and copy of completed commissioning sign-off document.

E. System Configuration Record
1. Provide a USB thumb drive, marked as “GCS Final Configuration”, with a snapshot copy of the GCS configuration taken from the GCS processor at the time of system configuration sign-off by the Owner and/or Theater Consultant, post-training. Mark USB stick with snapshot date.
2. Provide a separate USB thumb drive, marked as “Lighting Network Configuration”, with a snapshot copy of the Lighting Network configuration taken from the Network gateways at the time of system configuration sign-off by the Owner and/or Theater Consultant, post-training. Mark USB stick with snapshot date.

3. Provide a separate USB thumb drive, marked as “Relay Panel Processors Configurations”, with a snapshot copy of the Relay Panel Processors configurations taken from the Relay Panel Processors for the Stage at the time of system configuration sign-off by the Owner and/or Theater Consultant, post-training. Mark USB stick with snapshot date.
4. Additionally mark each stick with the name of the facility. All marking shall use durable adhesive labels or securely attached labeling disks.
5. Enclose all USB sticks in a heavy-wall plastic pouch, with holes and reinforcement for mounting in a 3-ring binder, with quick-zip enclosure.
6. Provide a duplicate copy of all sticks, with identical labeling, sent to the Theater Consultant’s primary office.

F. Warranty Document
1. Include an originally signed copy of all primary factory and OEM factory warranties in the project closeout package.

G. Deliver package to the Owner as part of the overall project closeout process.
1. Refer to Division 01 for general requirements.

END OF SECTION 26 0961

SECTION 26 0962-PRODUCTION VENUE DISTRIBUTION DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results: Furnish and install a complete package of Theater Lighting Distribution Devices for the Stage.

B. Related Requirements: Drawings and general provisions of the Contract, including General and Special Conditions and other Division 01 General Requirement sections, apply to the work in this section.

1.2 PRICES AND PAYMENT PROCEDURES

A. Allowances: There are no allowance items in this section.

B. Unit Prices: There are no unit price requirements in this section.

C. Substitutions:
   1. As required under Division 01, except where additional requirements are listed in this and other individual Sections referenced herein.
   2. All bids shall be submitted based exactly on the contents and brand/models as specified of the 'TL' series drawings.
   3. No product or device may be substituted without written authorization from the Theater/Assembly Space Consultant. TELEPHONE REQUESTS FOR APPROVAL WILL NOT BE ALLOWED. Only properly completed and signed CSI Substitution Request Forms with full technical catalog data sheets will be considered.
   4. Pre-bid approval of substitute product manufacturers does not relieve the contractor and/or the product manufacturer from compliance with the functional and operational requirements of the Specifications. All products will be carefully evaluated during the submittal review process. If, at that time, any pre-bid approved substitute is found to be unsatisfactory and not in compliance, the contractor then must re-submit and supply the specified product(s) without additional costs to the Owner and/or delay to project.

D. If a manufacturer is listed in this section of the Specification as an approved equivalent, but no specific product model is listed, then the Contractor must submit complete factory technical data sheets and a Bill of Materials of the factory's interpretation of equivalent product, along with their CSI request. Such submittal shall be handled in review as a pre-bid substitution request.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Project Meetings: Refer to Division 01 requirements.

B. Preconstruction Evaluation: Refer to Division 01 requirements.

C. Construction Documentation: Refer to Division 01 requirements.

D. Special Administrative Requirements: Refer to Division 01 requirements.

1.4 SUBMITTAL REQUIREMENTS

A. Submittals for Review: Product Data: Provide Manufacturer's Data / Specification Sheets and Bill of Materials cross-referenced to 'TL' series drawing Distribution and Control ID tags.

B. Shop Drawings: Provide detailed fabrication drawings for all Stage Lighting Distribution Devices, showing verified dimensions and attachment hardware. Show and call out all major components of each Device. Cross-reference all drawings to 'TL' series drawing Distribution and Control ID tags.

C. Samples: Refer to Distribution Device Schedule on 'TL' series drawings for any specific sample requirements.

D. All submittal documents shall be clearly legible in 11x17 format. No exceptions.

E. Submittals for work of this specification section shall be integrated and coordinated with the submittal package and equipment in Section 26 09 61, and shall be submitted for review as one package at the same time.

1.5 REFERENCES

A. Abbreviations and Acronyms: Refer to 'TL' series drawings for any special definitions related to this work

B. Definitions: Refer to 'TL' series drawings for any special definitions related to this work

C. Reference Standards:
   1. The following listed codes, standards, and regulations refer to the latest current edition and are to be considered a part of this Section: ASTM, AISC, NEC, NESC, NEMA, NFPA, UL, IEEE, ANSI, USITT, -ESTA, OSHA, and OSSC.
   2. All equipment where applicable standards have been established shall be listed and labeled by Underwriters Laboratories or other locally approved testing agency. All Lighting Instruments and Electrical Accessories shall be UL listed and labeled for use as theatrical lighting.
   3. Contractor is responsible for insuring compliance with all applicable building, product, and installation codes (including but not limited to IBC, NEC, NEMA and UL) that are in effect at the time of the installation. Corrections to any product, assembly or work performed under this contract to obtain code compliance shall be at contractor's expense.
   4. Custom assemblies shall meet all applicable codes and where local jurisdictions require shall be inspected and approved by the local code authority at the Division 26 installer's expense.

5. Custom field assemblies shall meet all applicable codes and where local jurisdictions require shall be inspected and approved by the local code authority at Division 26 installer's expense.

1.6 TEMPORARY FACILITIES AND CONTROLS

A. Temporary Use of Permanent Work: Refer to Division 01 requirements.

B. Additional to Division 01 requirements, use of devices provided under this section shall require the Division 26 contractor to replace, or clean and refurbish item(s) to "as new out of box" condition, if damaged during storage, installation or post-installation but prior to theater facility handoff to Owner.

1.7 INTEGRATION AND COORDINATION

A. Devices covered by this section of the specification may be fabricated by the approved manufacturers listed in each product-type subsection in Part 2 below. Due to the fact that distribution devices are interrelated with lighting control equipment specified in Section 26 09 61, the manufacturer of the lighting control system shall be responsible for integration of the distribution devices into their total equipment package, even if the devices are fabricated by a separate, approved manufacturer.

B. The shop drawings/submittals for distribution devices shall be integrated and coordinated with the shop drawings/submittals for the lighting controls and submitted together as one submittal package by the lighting control manufacturer in Section 26 09 61.

PART 2 - PRODUCTS

2.1 SUMMARY

A. Power outlet distribution devices specifically designed and tested for use with theatrical lighting fixtures and lighting accessories.

2.2 RELATED PRODUCTS

A. Section 26 09 61 – Production Venue Lighting Controls

2.3 SOURCE

A. Product Options – All options are specified in each device type sub-section below.

B. Substitution Limitations – No substitutions shall be allowed. All acceptable manufacturers are listed in each device type subsection below.

C. Source Qualifications – Not less than 5 years' experience manufacturing theatrical lighting distribution devices which are listed and labeled accordingly by a nationally recognized testing laboratory.

D. Source Listing – Acceptable Manufacturers vary on an item basis. Refer to each Device type sub-section below.

2.4 PRODUCT SCHEDULE

A. Refer to 'TL' series drawings for Distribution Devices

2.5 "SDE" POWER ENCLOSURE AT STAGE - SUBMERSIBLE

A. Provide IP68 Power Enclosure, submersible up to 30 ft

B. Power Enclosure shall contain the following components:
1. (1) Set 300A 120/208v 3PH, 2N+G Camlock Panel, with receptacles (Tour Power - Lighting & Rigging)
2. (1) Set 100A 120/208v 3 PH, 1N+2G Camlock Panel, with receptacles (Tour Power – Audiovisual, Insulated Ground)
3. (3) DMX Output Jacks (Provided under section 260961)
4. (2) DMX Input Jacks to Aux Rack (Provided under section 260961)
5. (2) Network Jacks for A/V
6. General 120V / 20A Stage Power – GFCI 20A 5-20RD Receptacles for Lighting and AV (AV-Insulated Ground)
7. Rack mount DMX / RDM Lighting Network Gateways. (Provided under section 260961)
8. DMX Splitter RSN Opto 1x16 (Provided under section 260961.)

C. Approved Products – Power Enclosure:
1. Nemaco
2. Or prior approved by Addendum

2.6 CONTROL PAD POWER ENCLOSURE - SUBMERSIBLE

A. Provide IP68 Power Enclosure, containing the following components:
1. DMX Input Receptacles (Provided under section 260961)
2. Lighting Network Jack (Provided under section 260961)
3. AV Link Network Jacks
4. AV Mic Jacks (specified by others)
5. General 120V / 20A Power – GFCI 20A 5-20RD Receptacles for Lighting and AV (Insulated Ground)

B. Approved Products – Power Enclosure:
1. Nemaco
2. Or prior approved by Addendum

2.7 LOADING DOCK POWER OUTLET ENCLOSURE - SUBMERSIBLE

A. Provide IP68 Power Enclosure, containing the following:
   1. (3) 50/3 twist lock receptacles (For owner spider, breakout boxes)
   2. (1) 20/1 twist lock receptacle (For portable dock lift)

B. Approved Products
   1. Nemaco
   2. Or prior approved by Addendum

2.8 DELIVERY, STORAGE AND HANDLING

A. Do not deliver Theater Lighting Distribution Devices until immediately prior to the point building is ready for their installation.

B. Protect from damage during delivery, handling, and storage.

C. Inspect all components in their original shipping cartons and packing to discover damage. Immediately process damage claim and replacement of equipment so as to not delay project.

D. Protect devices from damage by dust, dirt, and the work of all other trades.

2.9 FIELD SAMPLES / MOCKUPS

A. If requested by Architect, provide samples of Theater Lighting Distribution Devices which match the devices as specified herein.

2.10 LOCATIONS & SCHEDULES

A. Refer to ‘TL’ series drawings for locations.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. Dispose of all packing materials in accordance with General Requirements.

3.2 SITE QUALITY CONTROL

A. Site Testing and Inspections
   1. Test circuit continuity of all Theater Lighting Distribution Devices.
   2. Confirm that circuit ID labels match the actual source ID.

3.3 CLOSEOUT ACTIVITIES

A. Cleaning: Remove construction dust and debris from enclosures and outlet terminals immediately prior to facility turn-over to Owner.

B. Protection: Protect all devices from overspray of paint and other building applied materials.

C. Demonstration: Demonstrate proper use of devices and device accessories.

D. Training: Provide training to Owner's designated personnel regarding proper use, care, and maintenance of Theater Lighting Distribution Devices and related accessories.

3.4 WARRANTY

A. All major components shall carry a manufacturer's and/or installer's warranty, which shall guarantee against defects in materials and workmanship for a period of two years. Refer to Division 01 for the start of the warranty period.

B. Warranty must include all shipping expenses including, but not limited to, return shipping of items which do not meet these specifications.

C. The warranty period shall not start until all punch list items have been rectified.

D. The Contractor shall warrant materials and workmanship of systems and equipment installed as free of defects. The Contractor shall guarantee in writing the repair or replacement within two calendar weeks for any item found defective during the warranty period. Ordinary wear and defects due to improper usage are not covered.

E. During the warranty period, all emergency conditions where system failures may be hazardous or may cause severe hardship or cancellation of events and performances shall be responded to within 24 hours.

F. If start of warranty is delayed due to delay in contractor completing the punchlist items, and owner has commenced use of the facility, the Contractor shall provide the same level of service and responsibility defined herein.

END OF SECTION 26 0962

SECTION 26 0963-GENERAL LIGHTING FOR PRODUCTION VENUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General Conditions, Supplemental Conditions and Division 1 Specification Sections, apply to work of this Section.

1.2 SECTION INCLUDES

A. GENERAL LIGHTING: Provide fixtures, drivers and accessories as specified herein and defined on ‘TL’ Series drawings.

1.3 RELATED REQUIREMENTS

A. Provision, installation and connection of line and load side electrical conduit and wiring, shall be performed under Division 26, unless otherwise noted.

B. Provision, installation and connection of all wiring and conduit required to execute the work as defined in the ‘TL’ Series drawings shall be performed under Division 26.

C. Receiving, uncrating and installation of all general lighting fixtures and related equipment shown on the ‘TL’ Series drawings shall be performed under Division 26.

D. Abbreviations and Acronyms: Refer to ‘TL’ Series drawings for any special definitions related to this work.

E. Definitions: Refer to ‘TL’ Series drawings for any special definitions related to this work

1.4 REFERENCE STANDARDS

A. The following listed codes, standards, and regulations refer to the latest current edition and are to be considered a part of this Section: ASTM, AISC, NEC, NESC, NEMA, NFPA, UL, IEEE, ANSI, USITT, ESTA, OSHA, and OSSC.

B. All equipment where applicable standards have been established shall be listed and labeled by Underwriter's Laboratories or other locally approved testing agency. All equipment covered by this section of the specifications shall be UL listed and labeled for use as theatrical lighting controls.

C. Contractor is responsible for insuring compliance with all applicable building, product, and installation codes (including but not limited to the local version of the IBC and NEC) that are in effect at the time of the installation. Corrections to any product, assembly or work performed under this contract to obtain code compliance shall be at contractor's expense.

D. Custom field or factory assemblies shall meet all applicable codes and where local jurisdictions require shall be inspected and approved by the local code authority at the Contractor's expense.

1.5 SUBSTITUTIONS

A. As required under Division 1, except where additional requirements are listed in this and other individual Sections referenced herein.

B. All bids shall be submitted based exactly on the contents and brand/models as specified of the 'TL' series drawings. No product or device may be substituted without written authorization from the Architect and Theatre Consultant. TELEPHONE REQUESTS FOR APPROVAL WILL NOT BE ALLOWED. Only properly completed and signed CSI Substitution Request Forms with full technical catalog data sheets will be considered.

C. Pre-bid approval of substitute product manufacturers does not relieve the contractor and/or the product manufacturer from compliance with the functional and operational requirements of the Specifications. All products included by the Contractor in their bid, will be carefully evaluated during the submittal review process. If, at that time, any substitute product that was approved based on manufacturer's catalog data or samples during the pre-bid process, is found to be unsatisfactory and not in compliance either by submittal review or in the field, the contractor then must re-submit and supply the specified product(s) without additional costs to the Owner and/or delay to project. Manufacturers requesting pre-bid approval shall provide a fully functional system documented in detail in any Substitution Request package. If the Architect or Theater Consultant does not discover missing or conflicting elements in the Substitution Request package that are insufficient compared to the functional features of the equipment specified as the "Basis of Design" in the contract documents, the Contractor is still required to provide equipment that complies with the contract documents, at no additional cost to the Owner.

D. Substitution Approval product information sheets that have been edited by local sales representatives or electrical suppliers, to add or modify features that are otherwise different on the manufacturer's original published document, shall not be approved unless they are accompanied by an acknowledgment memo on company letterhead, signed by a fully authorized employee of the manufacturer, giving clear and unambiguous assent that the feature on the locally modified product sheet is and will be honored and executed by the manufacturer. Furthermore, any modification to the standard published feature shall be accompanied by full engineering documentation as to how the deviation is accomplished and integrated to and with the product and how it integrates or affects the overall system.

1.6 SUBMITTALS

A. Provide submittals per the Division 01 requirements.

B. The submittals shall include catalog data sheets with the particular product item called out by red arrow. Submittals shall include factory dimensional and installation drawings.

C. Shop Drawings: Indicate all major system components by manufacturer's catalog number. Provide catalog cuts and operational and technical specifications for all major system components. Provide detailed fabrication drawings for all custom fabricated equipment.

D. Samples: Refer to Lighting Fixture Schedule on 'TL' series drawings for any specific sample requirements.

E. Submittal product sheets that have been edited by local sales representatives or electrical suppliers, to add or modify features that are otherwise different on the manufacturer's original published document, shall not be approved unless they are accompanied by an acknowledgment memo on company letterhead, signed by a fully authorized employee of the manufacturer, giving clear and unambiguous assent that the feature on the locally modified product sheet is and will be honored and executed by the manufacturer. Furthermore, any modification to the standard published feature shall be accompanied by full engineering documentation as to how the deviation is accomplished and integrated to and with the product and how it integrates or affects the overall system.

PART 2 - PRODUCTS

2.1 LED RECESSED DOWNLIGHTS – TYPES 'HA', 'HB', 'HC', & 'HD'

A. Furnish, install, configure and test as per this section of the specification, in types and quantities as defined in the Lighting Fixtures Schedule on the 'TL' series drawings.

B. Field confirm required fittings, adapters, dimensions and clearance prior to ordering components.

C. Mount and connect to be used properly compatible with wiring and lighting controls.

D. Approved Manufacturer: Refer to Lighting Fixture Schedule on 'TL' drawings.

2.2 LED RGBA UP LIGHT AT COLUMNS – TYPE 'HG'

A. Furnish, install, configure and test as per this section of the specification, in types and quantities as defined in the Lighting Fixtures Schedule on the 'TL' series drawings.

B. Field confirm required fittings, adapters, dimensions and clearance prior to ordering components.

C. Mount and connect to be used properly compatible with wiring and lighting controls.

D. Approved Manufacturers: Refer to Lighting Fixture Schedule on 'TL' series drawings.

2.3 DIRECTLY CONTROLLED LUMINAIRES (for emergency egress lighting)

A. All lighting fixtures used for emergency egress lighting, which utilize a separate signal input for control, with the ability to detect qualified events that would trigger the need for emergency egress illumination shall be listed and labeled accordingly.

PART 3 - EXECUTION

3.1 GENERAL

A. The contractor shall coordinate with all other trades regarding placement and connection of equipment prior to installation of equipment.

B. Before installation work the contractor shall verify that approved shop drawings reflect the actual field requirements. Report any deviation between field conditions and shop drawings to the Architect in writing.

C. Manufacturer shall provide detailed and specific installation instructions to the Contractor for proper installation of the equipment.

D. Contractor shall provide all mounting hardware needed for proper installation of the equipment per manufacturer recommendations and requirements.

E. All deviations from the system design on the Contract Documents must be preceded by an approved RFI submission (from the Contractor) that has been reviewed by the Architect and the Theater Consultant. If deviations are found during a job observation visit or during punchlist site visit, the Theater Consultant and/or Architect may direct the Contractor to re-do the work to comply with the contract documents, at no additional cost to the Owner or Architect's design team, if said deviations are not the result of a directive issued in response to a timely submitted RFI.

F. The Contractor shall be responsible for any and all corrections to the system that shall be made by the manufacturer and shall compensate the Theater Consultant for any time that is required to perform or coordinate the performance of services that are the responsibility of the contractor and or their subcontractors and vendors in the event that the subcontractor or vendors do not respond in a timely and appropriate fashion during the punchlist, closeout, testing, demonstration and warranty periods.

G. After receipt of the punchlist, the Contractor shall perform all work necessary to rectify the items on the punchlist. Once all items have been rectified, the Contractor shall notify the Architect in writing that the work is ready for back-check of the punchlist. If during the onsite back-check review, the Architect and/or Theater Consultant observe incomplete or incorrect items necessitating another punchlist and another back-check, the Contractor shall provide compensation for all return site visits and time required to generate follow-up reports.

3.2 TESTING

A. Test each fixture and all related accessories for proper functionality and safe operation prior to setting in place.

B. Provide temporary power and signal connections to fixtures, and set addressing and parameters for digitally controlled fixtures, while on the ground.

C. Provide factory technician for configuration, including RDM setup.

D. Once fixtures are tested and configured, demonstrated to be in complete, proper working order, disassemble testing and configuration setup and install fixtures / drivers in permanent locations as specified and shown on drawings.

E. Consult with manufacturer for setting, connection and mounting details prior to install.

3.3 WARRANTY/GUARANTEE

A. All major components shall carry a manufacturer's and/or installer's warranty, which shall guarantee against defects in materials and workmanship for a period of two years, commencing at Final Completion. Refer to Division 01 for requirements related to Closeout Procedures & Closeout Submittals for other general requirements.

B. Warranty must include all shipping expenses including, but not limited to, return shipping of items which do not meet these specifications.

C. The warranty period shall not start until Final Completion.

D. The Contractor shall warrant materials and workmanship of systems and equipment installed as free of defects. The Contractor shall guarantee in writing the repair or replacement within two calendar weeks for any item found defective during the warranty period as defined in 3.3, A above. Ordinary wear and defects due to improper usage is an exception.

E. During the warranty period, all emergency conditions where system failures may be hazardous or may cause severe hardship or cancellation of events and performances shall be responded to within 24 hours.

F. If start of warranty is delayed due to delay in contractor completing the punchlist items, and owner has commenced use of the facility, the Contractor shall provide the same level of service and responsibility defined herein.

END OF SECTION 26 0963

SECTION 26 0993-SEQUENCE OF OPERATIONS FOR LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Abbreviations and Definitions
   2. General Controls Approach
   3. Space-by-Space Sequence of Operations

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 ABBREVIATIONS AND DEFINITIONS:

A. BACNET Protocol for integration with BAS/BMS/EMS

B. BAS / BMS / EMS Building Automated System, Building Management System, Energy Management System

C. D Dimming Wall Switch

D. FC Footcandles. The metric for measuring light levels / illuminance levels

E. GUI Graphic User Interface

F. LCP Lighting Control Panel

G. LonWorks Protocol for integration with BAS/BMS/EMS

H. OS/VS Occupancy Sensor / Vacancy Sensor
   1. Occupancy sensors provide automatic on and automatic shut-off.
   2. Vacancy sensors provide automatic shut-off only and require manual-on.

I. PC Photocell

J. RS RS-232 Connection for AV Integration

K. SC Scene Control

L. TC Timeclock, or astronomical timeclock

M. WS Wall Switch

N. WS/O Wallbox Occupancy Sensor Switch
1. Wall Switch with integrated Occupancy Sensor.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 SPACE-BY-SPACE SEQUENCE OF OPERATION

A. Exterior Lighting:
1. All park site luminaires to function via lighting relay panel with astronomical timeclock for automatic on, automatic off, for dusk/till-dawn operation. The digital astronomical time clock is to possess conditional logic which allows multiple lighting zones to have independent schedules depending upon seasonal conditions.
2. All exterior lighting is to automatically turn off at dawn.
3. Coordinate final timeclock settings for each relay group with Owner.

B. Electrical Room:
1. Rooms where personal safety is a concern to have line voltage switches only.

END OF SECTION 26 0993

SECTION 26 2416-PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Branch Panelboards
   2. Identification

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 SUBMITTALS

A. Shop Drawings

B. Product Data
   1. Detailed component material list.
   2. Voltage rating, amperage rating, bussing material, fault rating, wiring lugs capacity, mounting method, physical size, exterior finish, and options.
   3. Individual circuit breaker product data sheets.
   4. Panel schedules indicate circuit breakers in the same orientation as the construction documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Square-D

B. General Electric

C. Siemens

D. Eaton Cutler-Hammer.

2.2 BRANCH PANELBOARDS

A. Branch Circuit Panels:
   1. Bolt-on circuit breaker type fitted with metallic flush lift latches and locks keyed alike.

2. Deliver panel keys to the Owner at completion of the project.

B. Short Circuit Current Rating (SCCR):
1. Fully rated at a value greater than the maximum available short circuit current that can be expected at the panelboard location in the electrical system.
2. Series rating is not permitted.

C. Cabinets:
1. Cabinet rough-in boxes code gauge steel, with dead front covers.
2. Flush panels have flush doors with concealed hinges and mounting clamps.
3. Surface panels have metal face trims with no sharp edges or corners.
4. Surface panel cabinets fabricated without knockouts and finished to match face trim.
5. Panels have door in door hinged trim fronts that provides full access to wiring compartment.

D. Wiring Gutters:
1. Minimum of 4-inches wide except where feeder conductors enter where a minimum of 6-inches clear.
2. Feeder conductors to enter directly in line with lug terminals wherever practicable.
3. Provide separate feeder studs for each feeder conductor compression lug.

E. Bussing:
1. Provide one continuous bus bar per phase.
2. Provide copper or electrical grade aluminum alloy sized as indicated on the drawings and in accordance with UL standards to limit temperature rise on current carrying part to a maximum of 149 degrees F above an ambient temperature of 104 degrees F maximum.
3. Full size insulated neutral bars included for panels indicated to have a neutral.
4. Bus bar taps for panels with single pole branches arranged for sequence phasing of the branch circuit devices.

F. Ground Bus: Provide in each panelboard and include the following:
1. Have the same rating as the neutral bus.
2. Contain a ground conductor terminal for each available circuit in the panelboard.
3. Size terminals for branch circuit equipment grounding conductors.

G. Interiors:
1. Main lug only unless otherwise indicated, with dead front shield covering the bus, and bus connectors, with mounting hardware and bussing for spaces indicated for future installation of devices.
2. Dead front construction for interior trim.
3. Cover unused mounting spaces with preformed knockouts.

H. Main Circuit Breaker:
1. Where indicated, equip panels indicated with main circuit breakers sized as scheduled and mounted behind door at top of panel for top entrance feeders, and bottom of panel for bottom entrance feeders.

2. Where main circuit breaker size is not indicated, ampere rating match feeder ampacity, or panelboard rating, whichever is less.
    a. Molded case, thermal magnetic bolt-on type and sized as indicated on the Drawings. Circuit breaker have an over center, trip-free, toggle mechanism that provide quick-make, quick-break contact action. Indicate open, closed, or tripped by handle position, with common internal trip crossbar to provide simultaneous tripping for poles.
    b. Circuit breakers have a permanent trip action with thermal and magnetic trip elements in each pole. Each thermal element factory calibrated to operate in a 104 degrees F ambient environment. Thermal elements ambient compensating above 104 degrees F.
    c. Provide the main circuit breaker with a padlock-able lock-off device to provide capability to be locked in the open position.

I. Branch Circuit Breakers:
1. Provide with amperage rating, and number of poles as indicated in the Panelboard Schedules.
2. Bolt-on type circuit breakers.
3. Over center toggle mechanism that provide quick-make, quick-break contact action. Circuit breakers have thermal and magnetic trip elements in each pole. Two and three pole circuit breakers have an internal common trip crossbar to provide simultaneous tripping.
4. Exposed faceplates of circuit breakers flush with one another.
5. Short circuit capacity rating to withstand the maximum short circuit duty that can be expected at the breaker location in the electrical system. Minimum short circuit rating for circuit breakers: 10,000 AIC for 120V and 208V breakers, 14,000 AIC for 277V and 480V breakers.
6. Circuit breakers used for switching duty UL listed for that purpose and marked SWD.
7. Provide each branch circuit breaker with a factory padlock-able lock-off provisions.

J. Provide shunt trips, alarms, and auxiliary switches as shown on the Drawings.

K. Provide Arc Fault Circuit Interrupter (AFCI) breakers as shown on the Drawings or as required by Code.

L. Provide Ground Fault Interrupter (GFI) Circuit breakers as shown on the drawings or as required by Code. GFI breakers serving heat trace circuits 30 ma ground fault trip rating.

M. Surge Protective Device (SPD): Provide an integral or separate SPD with panelboards as indicated on drawings. Refer to Section 26 43 13, Surge Protective Devices for requirements.

2.3 IDENTIFICATION

A. Identify branch circuit breakers with individual circuit numbers adjacent to each breaker with a typewritten card to identify the load controlled by that breaker.

B. Provided with complete schedules of panelboards as designed prior to start of construction. Schedules will include circuit breaker arrangement, load schedules, and ratings for use in identification of circuits and coordination.

C. Refer to Section 26 0553, Identification of Electrical Systems for additional requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with manufacturer's recommendations.

B. Install panelboards plumb and level, located as shown on the Drawings up 6-feet – 6-inches to top unless noted otherwise.

C. Keep area above panelboard clear of equipment foreign to the electrical installation. Coordinate installation with other trades.

D. Provide identification and panel schedules as specified in Section 26 0553, Identification of Electrical Systems.

3.2 SALVAGE

A. Utilize circuit breakers in existing panels that are to remain. Where faulty or inadequate breakers are found in these panels, replace with suitable breakers from panels removed during demolition.

END OF SECTION 26 2416

SECTION 26 2726-WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Line Voltage Wall Switches
   2. Receptacles
   3. Plates

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 SUBMITTALS

A. Product Data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Line Voltage Wall Switches:
   1. Hubbell
   2. Leviton
   3. Arrow-Hart
   4. Pass & Seymour

B. Receptacles:
   1. Use same manufacture as the Line Voltage Wall Switches.
   2. Hubbell
   3. Leviton
   4. Arrow-Hart
   5. Pass & Seymour

C. Plates:
   1. Hubbell
   2. Leviton
   3. Arrow-Hart
   4. Pass & Seymour

2.2 MATERIALS

A. Extra heavy-duty grade wiring devices, with special devices as noted on the Drawings. Should the Drawings indicate a device other than those listed. Device of same grade and manufacture as specified below. Furnish a matching plug connector for special purpose devices that do not have the common 120V NEMA 5-20R configuration.

B. Lighting switches and duplex receptacles installed have similar appearance characteristics unless noted otherwise.

2.3 LINE VOLTAGE WALL SWITCHES

A. Line Voltage Switches:
   1. 20A rated, 277V, quiet type, extra heavy duty, heavy duty nylon toggle handle, back, and side wired with screw terminal connections.
   2. As noted on the drawings provide:
      a. Pilot light switch: lighted clear toggle.
      b. Momentary Contact Switches: 15A, SPDT, center off.
      c. Key Switches: 20A, 277V, back and side wired with screw terminal connections.

B. Except as noted herein, device exposed finish color as follows:
   1. Normal Power: Gray

2.4 RECEPTACLES

A. Standard Straight Blade Duplex Receptacle:
   1. 3-wire, 2-pole with grounding, extra heavy duty, 20A rated, NEMA 5-20R configuration, back and side wired with screw terminal connections.
   2. Ground Fault Interrupting straight blade duplex receptacle:
      a. Heavy duty, 3-wire, 2 pole with grounding, self-testing, green “ON” LED to indicate power, red “ON” LED to indicate ground fault condition, 20A rated, NEMA 5-20R configuration, back and side wired with screw terminal connections.
         1) Provide weather-resistant rating at exterior locations as required by NEC.

B. Special Purpose Receptacles: As noted on Drawings with NEMA configurations.

C. Exposed Device Color, unless otherwise noted, is as follows:
   1. Normal power: Gray or as selected by Architect.

2.5 PLATES

A. Flush Finish Plates:
   1. 0.04-inch thick, Type 302 stainless steel, brush finish.

B. Surface Covers:
   1. Galvanized or cadmium plated steel, 1/2-inch raised industrial type with openings appropriate for device installed.

C. Weatherproof:
   1. Extra-Duty while in use covers, UL 514D listed, commercial quality die cast aluminum construction, NEMA 3R rated, gasketed, built-in padlock provisions, built-in cord strain relief provisions, gray powder-coated finish, vertical mounting as required for application or other covers of similar construction for other receptacle configurations.

D. Security Wall Plates:
   1. Tamper resistant cold rolled steel or cast aluminum with baked polyester powder enamel finish.
   2. Secure with 4 stainless steel Torx head screws.

E. Identification:
   1. Identify receptacle plates with a pre-printed label indicating serving panel and branch circuit number.
   2. Refer to Section 26 0553, Identification for Electrical Systems.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Devices and finish plates installed plumb with building lines. Install wall mounted receptacles vertically at centerline height shown on the Drawings.

B. Finish plates and devices are not installed until final painting is complete. Scratched or splattered finish plates and devices will not be accepted.

C. Switches, receptacles and/or other devices ganged into a common enclosure provided with a separation barrier between devices where the combined circuit voltages within the enclosure exceeds 300V.

D. Provide GFCI receptacles as shown on the drawings or as NEC required. Provide a GFCI type duplex receptacle in each required location, do not sub-feed normal receptacles downstream of the GFCI receptacle to obtain the GFCI rating.

E. Provide receptacles with GFCI, tamperproof, weather-resistant or hospital grade ratings as shown on the drawings, appropriate for the installation or required by NEC.

3.2 CORD CAPS

A. Special plugs provided with the receptacles given to the Owner in their cartons with a letter stating the date and the Owner’s representative that received the materials.

3.3 COORDINATION

A. Electrical Drawings indicate the approximate location of devices. Refer to Architectural elevations, sections, and details for exact locations.

B. Coordinate with equipment installer the locations and methods of connection to devices mounted in cabinets, counters, work benches, service pedestals, and similar equipment.

3.4 TESTING

A. Test receptacles for line to neutral, line to ground and neutral to ground faults. Correct defective wiring.

END OF SECTION 26 2726

SECTION 26 4313-SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. The Sections includes:
   1. Surge Protective Devices
   2. Enclosure

B. Surge Protective Devices (SPD) for low voltage power equipment and provide effective high energy protection against transient surges, temporary over-voltages, voltage swells and high frequency noise attenuation.

C. This Section describes the materials and installation requirements for Surge Protective Devices (SPD). SPD's are used for the protection of AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

D. This specification also describes the mechanical and the electrical requirements for the SPD. Suitable for application in both category B and C environments as described in ANSI/IEEE C62.41- 2002.

E. Furnish and install the Surge Protective Devices having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract documents. Provide related hardware (i.e. flush mounting kits, mounting brackets, etc.) as required for the installation of the SPD system suitable for the application.

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 REFERENCE STANDARDS

A. UL Underwriters Laboratories
   1. ANSI/UL 1449 Standard for Safety for Surge Protective Devices.

B. ANSI American National Standards Institute
   1. ANSI C84.1 American National Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hz).

C. IEEE Institute of Electrical and Electronics Engineers
   1. IEEE C62.41.1 Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits.

2. IEEE C62.41.2 Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
3. IEEE C62.45 IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
4. IEEE 142 IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (Green Book).
5. IEEE 1100 IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (Emerald Book).

D. ISO International Organization for Standardization
1. ISO 9001 Quality Systems – Quality Management System

E. MIL Standard 220 (Department of Defense) - Test Method Standard, Method of Insertion-loss Measurement.

F. NFPA 70 (National Fire Protection Association) - National Electrical Code.

G. UL 1283 (Underwriters Laboratories) - Standard for Safety for Electromagnetic Interference Filters.

1.4 SUBMITTALS

A. Include written specification response referencing each specification section and sub-section indicating compliance or non-compliance. If manufacturer cannot fully comply with specification section, this must be stated in the response along with a full description of the variance.

B. Submit the following information, indexed by response and test results. Receive a minimum of 2 weeks in advance of the date the submittal evaluation needs to be completed for the project.
1. Specification compliance response sheet referencing each specification section.
2. Proof of compliance to the current edition of UL1449 from a Nationally Recognized Test Lab (NRTL) accepted by local authority having jurisdiction. UL1449 Nominal Discharge Current Rating and Voltage Protection Ratings provided.
3. UL1283 filter compliance documentation.
4. Published specifications, cut sheets and product data with appropriate IEEE C62.41 and UL1449 (current edition) performance ratings for intended installation locations.
5. Electrical and Mechanical Shop Drawings.
6. Installation Requirements/Instructions.
7. Operations and Maintenance Manuals.
8. Performance/Warranty Information.

C. The Engineer reserves the right to accept or reject any or all submittals, to request additional information as deemed necessary or to request submittals for a different unit deemed more appropriate for this installation.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manuals

B. Warranty Documentation

C. Notes to Record Drawings

1.6 QUALIFICATIONS

A. UL1449 (current edition) compliance and listing from Nationally Recognized Test Lab (NRTL) accepted by local authority having jurisdiction. Type 1 compliance required for SPD intended for installation before (or after) Main Service Disconnect or Type 2 compliance for installation after Main Service Disconnect. Provide published UL1449 (current edition) Nominal Discharge Current Rating and Voltage Protection Rating.

B. Local representation and distribution within 400 miles of the project location to provide technical, warranty claim, and installation support for the project.

C. Manufacturer/vendor must be capable of supplying SPD for project within 30 days of receipt of order for orders of 25 units and less for models submitted in response to this specification.

D. Certified to latest ISO 9001 standard and registered for the design and manufacturing of SPD devices.

E. Provide access to a readily available factory engineer for answering questions about this product.

F. Only firms regularly engaged in the manufacture of SPD products for category C locations (ANSI/IEEE C62.41.1-2002), and whose products have been providing satisfactory service for not less than five years, considered. Upon request, provide a customer reference list, with a minimum of five contact names and current phone numbers.

G. Provide manufacturer qualifications as part of the submittal.

H. The successful manufacturer/vendor to assign a technical contact person for SPD application, installation, and warranty questions. Contact available to provide a response to a technical question within a maximum of two business days.

I. Single manufacturer capable of providing power system SPD’s.

1.7 DELIVERY, STORAGE AND HANDLING

A. Inspect for damage and replace any damaged device.

B. Store in a clean, dry space suitable for equipment and protect against damage.

C. Clean equipment and touch up minor scratches using suitable materials.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Provide equipment operation and maintenance manuals with each assembly shipped and include instruction leaflets and bulletins for the complete assembly and each major component.

1.9 WARRANTY

A. Minimum requirements:
   1. Period: 20 years from the date of substantial completion of service and activation of the system to which the SPD is attached.
   2. Full replacement of a suppressor which is damaged or fails to meet manufacturers published specifications and specifications provided within, without pro-rating value.
   3. No exclusions from failure or damage from any system anomaly (over-voltage, single phasing, lightning strike, etc. (IEEE 62.41.1).
      a. Exceptions: Failure caused by wiring error, loose, or missing Neutral to Ground Bond or Meggar Testing with SPD connected to power system.
   4. Factory or third party testing not required.
   5. Warranty applies independent of facility ownership / purchaser.
   6. Replacement unit to be at facility within 7 business days of receipt of written notification of failure at no cost to the customer (exception – custom configuration or special-order units).
   7. Replacements: same make, model and configuration as original unit unless otherwise requested or approved.
   8. Manufacturer site visit for validation of warranty claim: manufacturer/vendor must visit site within 3 days of notification at no cost. This section does not modify 1.12 (A) (6).
   9. No shipping, handling, examination, or other fees are allowed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Current Technology Inc. SPE Series, Leviton, Square D or of the same manufacture as the distribution equipment specified in Section 26 24 13, Switchboards.

B. The listing of specific manufacturers above does not imply acceptance of their products which do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer 10 days prior to the bid date. Provide complete submittals for review as described above.

2.2 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

A. Performance and Ratings:

1. Minimum durability and performance requirements are described below in accordance with test procedures outlined in ANSI/IEEE C62.45 and UL1449 (current edition). Provide test documentation as part of the submittal package. Provide information in a format which is easily to analyze and review. Submit the following test data as manufacturer published literature:
    a. Provide Peak Surge Current (Single Pulse Rated, 8/20µS, by mode, Amperes) with submittals document for each SPD proposed. For electrical equipment located at Service Entrance or Category C locations, Surge current rating a minimum of 160kA per phase / 80kA per mode for IEEE C62.41.1-2002 - Category C Low Exposure locations and 300kA per phase / 150kA per mode for IEEE C62.41.1-2002-Category C High Exposure locations or critical locations.
    b. Provide surge current ratings for each applicable protection mode (L-L, L-N, L-G and N-G) with submittals.
    c. Surge Current Rating: Minimum of 80kA per phase / 40kA per mode in low exposure locations or 120kA per phase / 60kA per mode for distribution switchboards or motor control centers in medium and high exposure / critical equipment locations and for IEEE C62.41.1-2002 - Category B and C Switchboard and Motor Control Center Locations.
    d. Provide surge current ratings for each applicable protection mode (L-L, L-N, L-G and N-G) with submittals.
    e. Surge Current Rating:
        1) Minimum of 80kA per phase / 40kA per mode for branch panel models in low, medium, and high exposure areas and for IEEE C62.41.1-2002 - Category B and C Panel and Sub-Panel Locations.
    f. Provide surge current ratings for each applicable protection mode (L-L, L-N, L-G and N-G) with submittals.
    g. For each SPD proposed, provide published durability test data utilizing the ANSI/IEEE C62.41-1991, Category C3, 20kV/10kA, 1.2 x 50 µS - 8x20 µS combination waveform for SPD durability tests with (as a minimum), the ANSI/IEEE C62.41-1991, Category C1, 6kV/3kA, 1.2 x 50 µS - 8x20 µS combination waveform used for pre and posttest measurement of let through performance variation. Provide test data with submittals, including test setup information.
    h. SPD devices withstand a minimum of 15,000 IEEE C3 20kV/10kA hits delivered at a rate not exceeding one pulse per minute without failure or degradation exceeding 5 percent using IEEE B3 6kV/3kA combination waveform for pre and post durability let through measurement evaluation. Lead length for testing and let through measurements, 6-inchs.
    i. UL Third Edition Nominal Discharge Current Ratings a minimum of 20kA per mode for SPD's to be installed at the Service Entrance (or where direct lightning strike potential exists on outdoor feeder or branch circuit conductors serving electrical equipment) and a minimum of 10kA per mode for all other locations.

j. Provide EMI/RFI Attenuation as per Mil Std-220. Attenuation 40dB at 100 kHz.

Maximum SPD voltage let through values are provided in Table 1 and 2 below. Provide published performance test data for the test configurations and waveforms listed in Tables with submittals. Table 1 - Peak Voltage Let Through Voltage Table for > 160 kA Units (at/ near Service Entrance locations)
*Peak Let Through Voltages (measured from zero reference) not to exceed the following:

Voltage / Configuration	Test / IEEE Wave	L-N	L-G	L-L	N-G	Phase Angle
120/208 Wye	C3 – 20 kV/10ka	1050	1225	1350	1150	90
120/208 Wye	B3/C1 – 6 kV/3kA	565	590	925	550	90
120/208 Wye	A1 – 2kV/67A	260	390	360	250	90
120/208 Wye	A1 – 2kV/67A	75	115	90	100	180
120/208 Wye	UL1449 SVR	400	400	800	400	-----
120/208 Wye	UL1449 VPR	600	700	900	600	-----

*Complete testing with a minimum of 6-inch of lead length outside of device enclosure and measured from zero voltage crossing.

Note: Category A1 Ringwave applicable for locations where active tracking units are to be installed, including 120/208 and 120/240 branch panels and protection for dedicated equipment loads (where noted).

Table 2 – Peak Limiting (Let Through) Voltage Table for > 80 kA Units (Branch/Sub Panel, MCC, etc.)
*Peak Let Through Voltages (measured from zero reference) not to exceed:

Voltage / Configuration	Test / IEEE Wave	L-N	L-G	L-L	N-G	Phase Angle
120/208 Wye	C3 – 20 kV/10ka	1050	1225	1350	1150	90
120/208 Wye	B3/C1 – 6 kV/3kA	560	585	920	540	90
120/208 Wye	A1 – 2kV/67A	260	400	370	250	90
120/208 Wye	A1 – 2kV/67A	75	100	75	75	180
120/208 Wye	UL1449 SVR	400	400	800	400	-----
120/208 Wye	UL1449 VPR	600	700	900	600	-----

*Complete testing with a minimum of 6” of lead length outside of device enclosure and measured from zero voltage crossing.

Note: Category A1 Ringwave applicable for locations where Active Tracking units are to be installed, including 120/208 and 120/240 Branch Panels and protection for dedicated equipment loads (where noted). Please note the phase angle is 90 degrees and measurement is positive peak voltage measured from zero reference. Measurements at 180 degrees will show significantly lower let through voltages (sine wave peak voltage is zero at 180 degrees).

2.3 SURGE PROTECTIVE DEVICES

A. Compatible with the electrical system voltage, current, system configuration and intended applications and NRTL listed for such application.

B. Parallel design only with individual protection components:
   1. Line to Ground and Line to Line for Delta and High Resistance Grounded systems.

2. Line to Ground, Line to Neutral and Neutral to Ground for Wye and Single-Phase distribution systems.

C. Utilize Metal-Oxide Varistors (MOV) components as primary energy mitigation. Selenium cell, air gaps, gas tubes are not allowed.

D. Maximum continuous operating voltage (MCOV) of components (based on ANSI C84.1 standard voltages), not less than 125 percent for 120/208-volt systems and 115 percent for other systems.

E. Short Circuit Current Ratings (SCCR): Suitable for location SPD is to be installed.

F. Visual indication of protection status on each phase, visible from the front of the equipment.

G. Protection Status:
1. Normally open and normally closed contacts for remote monitoring.
2. Rated a minimum of .5A, AC or DC.
3. Change state upon device failure or loss of power.

H. As a minimum, Branch Panel, Sub-Panel and series installed (branch circuit) SPD includes a passive circuit which allows the SPD to actively follow the voltage waveform and provide a clamping envelope to limit low level IEEE C62.41 Category A ring waves (of either polarity) at all locations on the sine wave. Circuit to perform in the Neutral to Ground Mode.

I. Provide complete, comprehensive installation instructions.

2.4 ENCLOSURE

A. NEMA rated metal enclosure appropriate for environmental conditions and exposure at point of installation.

B. Designed to allow connection of the SPD without sharp bends in the conductors.

C. Metal flush kits for flush mount installations (external devices) on new and retrofit applications for panels. Include supports for fastening to structural members and include a faceplate matching SPD finish. Retrofit kits capable of being installed next to the panel after drywall has been installed without the need for patching or refinishing of the wall.

PART 3 - EXECUTION

3.1 GENERAL

A. General Application and Installation Requirements
1. Per the manufacturer's installation instructions.
2. Per Installation Checklist.
3. NFPA 70 (NEC) Requirements.
4. Per IEEE C62.41.2, 141, 142 and 1100.
5. Local Authority Having Jurisdiction.
6. Project Engineer.

B. Tap directly to the bus without upstream over-current protection unless tap conductors are protected at their termination by NRTL listed Disconnect, Over-current and Short Circuit Protective Devices (Fuse with Disconnect and/or Circuit Breaker) properly rated for conductor and SPD Device Protection as per NRTL listing and NEC requirements.

C. Provide qualified personnel to provide one hour of on-site installation training for contractor.

D. Clean SPD units and flush mount covers and touch up with matching paint as necessary.

E. Inspect and test SPD devices as per manufacturer specification and installation guidelines.

F. Project Engineer or their appointed representative may perform inspection of the installed suppressors. Engineer reserves the right to require corrections to the installation to comply with manufacturer installation requirements and project specifications.

3.2 TESTING

A. Complete installation checks according to the manufacturers written instructions.

B. Remove and replace malfunctioning units and retest.

3.3 SERVICE ENTRANCE

A. Service Entrance Installation Requirements
   1. One primary suppressor at each utility service entrance to the facility or as indicated on the drawings.
   2. Connect suppressors to properly rated disconnect with overcurrent and short circuit protective device connected on the load side of the service entrance disconnecting means in accordance with NEC requirements.
   3. Conductors between suppressor and point of attachment kept as short and straight as possible and group together (via tie wrap) where possible. Lead length of connecting conductor not to exceed 2-feet without written permission of the Engineer.
   4. Bond suppressor's ground to enclosure frame and the service entrance ground bus, and conduit between the SPD and the switchboard must provide secure electrical/mechanical connections.

END OF SECTION 26 4313

SECTION 26 5600-EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of exterior fixtures, poles, and supports. The terms “lighting fixture”, “fixture” and “luminaire” are used interchangeably.

1.2 RELATED WORK

A. Section 03 30 00, CAST-IN-PLACE CONCRETE.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.

E. Section 26 09 23, LIGHTING CONTROLS: Controls for exterior lighting.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Provide luminaires acceptable to code authority for application and location as indicated.
   2. Comply with applicable ANSI standards pertaining to lamp materials, lamp power supplies and luminaires.
   3. Comply with applicable NEMA standards pertaining to lighting equipment.
   4. Provide luminaires and lampholders which comply with UL standards and have been listed and labeled for location and use indicated by a testing agency acceptable by the AHJ (e.g. UL, ETL, and the like).
   5. Comply with OESC as applicable to installation and construction of luminaires.

1.4 SUBMITTALS

A. Submit in accordance with the following requirements:
   1. Shop Drawings: Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
      a. Material and construction details, include information on housing and optic system.
      b. Physical dimensions and description.
      c. Wiring schematic and connection diagram.

d. Installation details.
e. Energy efficiency data.
f. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.
g. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).
h. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).
i. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following:
   a. Certification by the Contractor that the exterior lighting systems have been properly installed and tested.

B. Bidder's attention is called to the following procedure to be followed in submitting alternate fixture manufacturers to those specified:
   1. Lamp catalog data: Provide lamp specification sheet, which must include complete lamp code, lamp data and all physical and technical characteristics.
   2. Substitutions for the lamps will not be considered unless the general characteristics (lamp type, life, shape, material), photometric characteristics (initial lumens, mean lumens, CCT, CRI), electrical characteristics (current crest factor, minimum and maximum cathode resistance ratio) and the physical dimensions of the proposed lamp is equal to or exceeds the specification.
   3. Substitutions for the power supplies will not be considered unless the general characteristics (power supply type, power factor, circuit type, sound rating, insulation class, total input watts and other characteristics), electrical characteristics (supply current frequency), and the physical dimensions of the proposed power supply is equal to or exceeds the specification.
   4. If the bidder wishes to substitute fixtures from alternate manufacturers, bidder's attention is called to the dimensions of visible parts of luminaires (i.e. the aperture diameters of recessed fixtures) are binding to the bidder and cannot be changed without prior approval.
   5. Request for approval shall be accompanied by working fixture samples (with an appropriate lamp, complete photometric, mechanical and electrical data, list of materials and finishes and unit cost to the Owner) of both specified brand and the proposed substitute as required to make complete comparison and evaluation. The above data shall be delivered to the Architect. The fixture samples shall be furnished and installed, at the bidder's expense, at a location selected by the Architect. In addition, the bidder shall furnish the Owner and the Architect with the name and location of at least one completed project where each proposed substitute has been in operation for a period of at least twelve months, as well as name and addresses of the Owner and the Architect.

C. Submit factory shop drawings for all linear fixture types and any custom and/or specialty lighting types.

D. Approval: approval of shop drawings and/or product data does not relieve the contractor of the responsibility of providing a complete, coordinated and functioning installation. Incompatibilities among equipment and components including but not limited mismatched voltages, differing signal protocol, etc. shall be resolved at the sole responsibility and expense of the contractor.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):
1. LRFDLTS-17, Structural Supports for Highway Signs, Luminaires and Traffic Signals

C. American Concrete Institute (ACI):
1. 318-14, Building Code Requirements for Structural Concrete

D. American National Standards Institute (ANSI):
1. H35.1/H35 1M-17 American National Standard Alloy and Temper Designation Systems for Aluminum

E. American Society for Testing and Materials (ASTM):
1. A123/A123M-17 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. A153/A153M-16 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
3. B108/B108M-15 Aluminum-Alloy Permanent Mold Castings
4. C1089-13 Spun Cast Prestressed Concrete Poles

F. Federal Aviation Administration (FAA):
1. AC 70/7460-IL-15 Obstruction Lighting and Marking
2. AC 150/5345-43H-16 Obstruction Lighting Equipment

G. Illuminating Engineering Society of North America (IESNA):
1. HB-10-11 Lighting Handbook
2. RP-8-14 Roadway Lighting
3. LM-52-03 Photometric Measurements of Roadway Sign Installations
4. LM-72-97 (R2010) Directional Positioning of Photometric Data
5. LM-79-08 Approved Method for the Electrical and Photometric Measurements of Solid-Sate Lighting Products
6. LM-80-15 Approved Method for Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
7. TM-15-11 Luminaire Classification System for Outdoor Luminaires

H. National Electrical Manufacturers Association (NEMA):
1. C136.3-14 For Roadway and Area Lighting Equipment – Luminaire Attachments
2. C136.17-05(R2010)(S2017) Roadway and Area Lighting Equipment – Enclosed Side-Mounted Luminaires for Horizontal-Burning High-Intensity-Discharge Lamps – Mechanical Interchangeability of Refractors
3. ICS 2-00(R2005) Controllers, Contactors and Overload Relays Rated 600 Volts
4. ICS 6-93(R2016) Enclosures

I. National Fire Protection Association (NFPA):
   1. 70-17 National Electrical Code (NEC)
   2. 101-18 Life Safety Code

J. Underwriters Laboratories, Inc. (UL):
   1. 496-17 Lampholders
   2. 773-16 Plug-In, Locking Type Photocontrols for Use with Area Lighting
   3. 773A-16 Nonindustrial Photoelectric Switches for Lighting Control
   4. 1598-08 Luminaires
   5. 8750-15 Light Emitting Diode (LED) Equipment for Use in Lighting Products delivery, storage, and handling

K. Provide manufacturer's standard provisions for protecting pole finishes during transport, storage, and installation. Do not store poles on ground. Store poles so they are at least 305 mm (12 inches) above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.6 WARRANTY

A. Fixture Warranty: Provide no less than 12 months warranty on all new luminaires.

B. Lamp Warranty: Refer to Solid State section for warranty on LED light source and LED power supply.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS:

A. Pricing Guidelines
   1. Price quotations for specified materials (and labor cost at the contractor level) are to be quoted on a per item basis. Bidder participants, manufacturer to end supplier, warrant that prices are separate and are not part of a "lump-sum package," an "all-or-none package," or a "discounted package."

   2. Luminaires, materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2.2 POLES

A. General:
   1. Poles shall be as shown on the drawings, and as specified. Finish shall be as specified on the drawings.
   2. For all areas in 100-year flood zone, poles shall be mounted on a concrete footing as indicated on the structural drawings.
   3. The pole and arm assembly shall be designed for wind loading of 100 mph minimum, as required by wind loading conditions at project site, with an additional 30% gust factor and supporting luminaire(s) and accessories such as shields, banner arms, and banners that have

the effective projected areas indicated. The effective projected area of the pole shall be applied at the height of the pole base, as shown on the drawings.

4. Poles shall be anchor-bolt type designed for use with underground supply conductors. Poles shall have handhole having a minimum clear opening of 65 x 125 mm (2.5 x 5 inches). Handhole covers shall be secured by stainless steel captive screws.
5. Provide a steel-grounding stud opposite handhole openings, designed to prevent electrolysis when used with copper wire.
6. Provide a base cover that matches the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.
7. Hardware and Accessories: All necessary hardware and specified accessories shall be the product of the pole manufacturer.
8. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.

B. Types
   1. Refer to luminaire schedule for pole types.
      a. For all aluminum poles provide poles manufactured of corrosion-resistant AA AAH35.1 aluminum alloys conforming to AASHTO LTS-4. Poles shall be seamless extruded or spun seamless type.
      b. For steel poles, provide poles having minimum 11-gauge steel with minimum yield/strength of 48,000 psi and iron-oxide primed factory finish.

2.3 FOUNDATION FOR POLES

A. Foundations shall be cast-in-place concrete, having 3000 psi minimum 28-day compressive strength.

B. Foundations shall support the effective projected area of the specified pole, arm(s), luminaire(s), and accessories, such as shields, banner arms, and banners, under wind conditions previously specified in this section.

C. Place concrete in spirally-wrapped treated paper forms for round foundations, and construct forms for square foundations.

D. Rub-finish and round all above-grade concrete edges to approximately 6 mm (0.25-inch) radius.

E. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.

F. Prior to concrete pour, install electrode per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

2.4 LUMINAIRES

A. Refer to luminaire schedule to luminaire types.

B. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning and relamping.

C. Illumination distribution patterns, BUG ratings and cutoff types as defined by the IESNA shall be as shown on the drawings.

D. Incorporate power supplies in the luminaire housing, except where otherwise shown on the drawings.

E. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with prismatic refractors, unless otherwise shown on the drawings. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Pre-wire internal components to terminal strips at the factory.

G. Bracket-mounted luminaires shall have leveling provisions and clamp-type adjustable slip-fitters with locking screws.

H. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.

I. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.

J. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

K. Do NOT provide NON-LED luminaires unless otherwise specified in the luminaire schedule.

L. Samples:
1. Provide color chips for fixture finish for types E2 and E9.

2.5 LAMPS

A. Install the proper lamps in every luminaire.

B. Provide color temperature for lamps as indicated in the luminaire schedule.

C. Lamps shall be general-service, outdoor lighting types.

D. Do not provide High-Pressure Sodium (HPS) lamps, Metal Halide lamps, Low-Pressure Sodium (LPS) lamps, or Mercury Vapor lamps.

E. SOLID STATE LIGHTING / LED LUMINAIRES shall meet the following requirements:
1. General:
    a. Luminaire manufacturer shall have a minimum of five (5) years' experience in the manufacture and design of LED products and systems and no less than one hundred (100) North American installations.
    b. Unless otherwise specified, all LED luminaires and power/data supplies shall be provided by a single manufacturer to ensure compatibility.
    c. All components, peripheral devices and control software are to be provided by and shall be the responsibility of a single entity. All components shall perform successfully as a complete system.

d. Include all components necessary for a complete installation. Provide all power supplies, synchronizers, data cables, and data terminators for a complete working system.
e. All LED sources used in the LED luminaire shall be of proven quality from established and reputable LED manufacturers and shall have been fabricated after 2007. Acceptable LED lamp manufacturers unless otherwise noted are:
   1) Cree, Inc.
   2) Philips Lighting
   3) Nichia Corporation
   4) Norlux
   5) Opto Technology, Inc.
   6) Osram Optronic Semiconductors

2. Replacement and Spares:
   a. LED light engine shall be removable and field replaceable independent of luminaire.
   b. Manufacturer shall provide written guarantee of the following:
      1) Manufacturer will keep record of original bin for each LED module and have replacement modules from the same bin available for three (3) years after date of installation.
      2) Manufacturer will keep an inventory of replacement parts (source assembly, power and control components).
      3) Manufacturer's LED system will not become obsolete for ten (10) years: Manufacturer will provide exact replacement parts, or provide upgraded parts that are designed to fit into the original luminaire and provide equivalent distribution and lumen output to the original, without any negative consequences.
   c. All parts of system shall be replaceable in field. Manufacturer shall provide written guarantee of the following:
      1) Manufacturer has in place a written recycling and re-use program, and will accept returned product and/or components for recycling or re-use.
      2) Manufacturer will properly dispose of non-recyclable components that are deemed harmful to the environment.
   d. System shall carry a full warranty for five (5) years. Manufacturer shall be responsible for cost of labor not to exceed $50 per individual part, and cost of shipping, to replace any component of the system that fails within 2 years of installation.

3. Products and Components – Performance
   a. LED luminaires and components shall be UL listed or UL classified.
   b. LED luminaires and components shall be CE certified.
   c. LED luminaires and components shall be PSE marked.
   d. All LED luminaires shall be subjected to the following JEDEC Reliability Tests for Lead-free Semiconductors: HTOL, RTOL, LTOL, PTMCL, TMSK, Mechanical Shock, Variable Vibration Frequency, SHR, Autoclave.
   e. To ensure luminaire quality, luminaire shall have been tested under accelerated life test conditions including an operating temperature span of 360 degrees F, and cyclic loading up to 60G.
   f. All products included in system shall use Mil-Std 810F, Random Vibration 7.698g as a minimum standard. In installations subject to vibration, luminaire shall be installed with vibration isolation hardware to sufficiently dampen vibrations.
   g. All LED components shall be mercury and lead-free.

h. All manufacturing processes and materials shall conform to the requirements of the European Union's Restriction on the Use of Hazardous Substances in Electrical and Electronics Equipment (RoHS) Directive, 2002/95/EC.
i. LEDs shall comply with ANSI/NEMA/ANSLG C78.377-2008 – Specifications for the Chromaticity of Solid State Lighting Products. Color shall remain stable throughout the life of the lamp. Color shall match approved sample.
j. White LEDs shall have a rated source life of 50,000 hours under normal operating conditions. RGB LEDs shall have a rated source life of 100,000 hours. LED "rated source life" is defined as the time when a minimum of 70% of initial lumen output remains.
k. Luminaire assembly shall include a method of dissipating heat so as to not degrade life of source, electronic equipment, or lenses. LED luminaire housing shall be designed to transfer heat from the LED board to the outside environment. Luminaire housing shall have no negative impact on life of components.
l. Manufacturer shall supply in writing a range of permissible operating temperatures in which system will perform optimally.
m. High power LED luminaires shall be thermally protected using one or more of the following thermal management techniques: metal core board, gap pad, and/or internal monitoring firmware
n. LEDs shall be adequately protected from moisture or dust in interior applications.
o. For wet and damp use, LED-based luminaires itself shall be sealed, rated, and tested for appropriate environmental conditions, not accomplished by using an additional housing or enclosure. Such protection shall have no negative impact on rated life of source or components, or if so, such reductions shall be explicitly brought to the attention of the designer.
p. All hardwired connections to LED luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
q. The LED luminaire shall be operated at constant and carefully regulated current levels. LEDs shall not be overdriven beyond their specified nominal voltage and current.
r. RGB LED luminaires shall utilize an equal combination of high brightness red, blue and green LEDs, unless otherwise noted, to provide up to 16.7 million additive RGB colors and shall be capable of at least 8-bit control.
s. Manufacturer shall be able to provide supporting documentation of the product meeting third party regulatory compliance.
t. Manufacturer shall ensure that products undergo and successfully meet appropriate design and manufacturability testing including Design FMEA, Process FMEA, Environmental Engineering Considerations and Laboratory Tests, IEC standards and UL/CE testing.
u. All LED luminaires (100% of each lot) shall undergo a minimum twenty-four (24) hour burn-in during manufacturing, prior to shipping.
v. Manufacturer shall provide Luminaire Efficacy (lm/W), total luminous flux (lumens), luminous intensity (candelas) chromaticity coordinates, CCT and CRI. optical performance, polar diagrams, and relevant luminance and illuminance photometric data. Provide data in IES file format in accordance with IES LM-79-2008, based on test results from an independent Nationally Recognized Testing Laboratory.

4. Supply shall be UL listed for Class 1 or Class 2 wiring.
5. Operating temperature rating shall be between -40 degrees C (-40 degrees F) and 50 degrees C (120 degrees F).

6. Correlated Color Temperature (CCT): 3500K for all new luminaires in the park, color temperature to match existing for City of Albany downtown standard, Dave Clark trail fixtures, and Pacific Power cobra head fixtures.
7. Color Rendering Index (CRI): ≥ 85.
8. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating Engineering Society (IES) LM79 for photometric performance and LM80 for lumen maintenance and L70 life.

2.6 LED DRIVERS

A. LED drivers

1. Drivers shall have a minimum efficiency of 85%.

2. Starting Temperature: -40 degrees C (-40 degrees F).

3. Input Voltage: 120 to 480 (±10%) volt.

4. Power Supplies: Class I or II output.

5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μs, 10kA/8 x 20 μs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.

6. Power Factor (PF): ≥ 0.90.

7. Total Harmonic Distortion (THD): ≤ 20%.

8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.

9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

2.7 EXISTING LIGHTIG SYSTEMS

A. For modifications or additions to existing lighting systems, the new components shall be compatible with the existing systems.

B. New poles and luminaires shall have approximately the same configurations, dimensions, lamping and reflector type as the existing poles and luminaires, except where otherwise shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.

B. Remote Mounting of Power Supplies: Distance between the power supply and fixture shall not exceed that recommended by power supply manufacturer. Verify, with power supply manufacturers, maximum distance between power supply and luminaire.

C. Pole Foundations:
   1. Provide concrete footings for pole-mounted lighting units and bollard lights at locations shown on site plan Drawings. Provide concrete footings as shown on Drawings or as recommended by manufacturer if not shown on Drawings. Minimum base height above grade in automobile areas is 30 inches. Install luminaire poles plumb and straight.
   2. Install pole concrete footings in undisturbed or compacted soil. Where soil is disturbed provide backfill and compaction per Division 2 Earthwork requirement.
   3. Excavate only as necessary to provide sufficient working clearance for installation of forms and proper use of tamper to the full depth of the excavation. Prevent surface water from flowing into the excavation. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath, and the end of conduit.
   4. Set anchor bolts according to anchor-bolt templates furnished by the pole manufacturer.
   5. Install poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
   6. After the poles have been installed, shimmed, and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 9 mm (0.375-inch) inside diameter through the grout, tight to the top of the concrete base to prevent moisture weeping from the interior of the pole.

D. Install lamps in each luminaire with non-integral light source.

E. Adjust luminaires that require field adjustment or aiming with Architect, Lighting Designer and or Owner, at such time of day or night as required.

F. Align luminaires that are not straight and parallel/perpendicular to structure and/or ground.

G. Egress Luminaires: Provide unswitched emergency circuit to emergency inverter.

3.2 GROUNDING

A. Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially-treated or lined connectors suitable and listed for this purpose.

3.3 CLEANING

A. Clean paint splatters, dirt, dust, fingerprints, and debris from luminaires.

B. Where finish of luminaires and poles has been damaged, touch up finish as directed by manufacturer's instructions.

3.4 ACCEPTANCE CHECKS AND TESTS

A. Verify operation after installing luminaires and energizing circuits.

END OF SECTION

SECTION 26 8410-ELECTRIC HEATING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Electric Wall Heaters

1.2 RELATED SECTIONS

A. Division 01, General Requirements

1.3 SUBMITTALS

A. Submit the following:
   1. Product Data: Showing performance data, ratings, electrical data, wiring diagrams, fusing quantity and types.
   2. Operating and Maintenance Data

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Electric Wall Heaters:
   1. King
   2. Chromalox
   3. Markel
   4. Cadet
   5. Q-Mark
   6. Other Manufacturers: Submit substitution request.

2.2 ELECTRIC WALL HEATERS

A. Description:
   1. Heavy duty, wall mounted forced air heater, complete with steel enclosure for surface mounting, fan and motor, steel sheathed heating elements with manual reset thermal overloads, capacity as indicated on drawings.
   2. UL listed and wired per NEC.

B. Thermostat: Unit mounted, built-in, adjustable, for freeze protection only.

PART 3 - EXECUTION

3.1 ELECTRIC WALL HEATERS

A. Install per manufacturer’s instructions. Comply with NEC and UL listings.

B. Install heaters in place with box trim flush with finished wall.

END OF SECTION 26 8410

SECTION 31 2000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades
2. Excavating and backfilling for buildings and structures.
3. Base course and subbase course for concrete concrete pavements.
4. Base course and subbase course for asphalt paving.
5. Excavating and backfilling for utility trenches.
6. Drainage fill for infiltration facilities.

1.2 SUBMITTALS

A. Product Data.

B. Aggregate Sieve Analysis.

C. Growing media: (at least 14 days in advance of construction).

1. Documentation for the two analyses described in article 2.1.N.1 and 2.1.N.2 of this specification (particle gradation with calculated coefficient of uniformity; and pH) shall be performed by an accredited laboratory with certification maintained current. The date of the analyses shall be no more than 90 calendar days prior to the date of the submittal. The report shall include the following information:

    a. Name and address of the laboratory.
    b. Phone contact and e-mail address for the laboratory.
    c. Test data, including the date and name of the test procedure.

2. A compost technical data sheet from the compost vendor. The analysis and report must conform to the sampling and reporting requirements of the US composting Council Seal of Testing Assurance (STA) program. The analysis shall be performed and reported by an approved independent STA program laboratory and be no more than 90 calendar days prior to the date of submittal.
3. Two gallon-sized bags of the blended material.
4. A description of the location, equipment, and method proposed to mix the material.

D. Infiltration test results.

E. CDF: Design mix and trial 28-day compressive strength test results.

1.3 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. Base Course: Course placed between the subbase course, or subgrade, and concrete, or hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

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

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

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

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

G. 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.

H. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or cement concrete.

I. Subgrade: Surface or elevation remaining after completing excavation, or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

J. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

K. Drainage Fill: Free draining, open-graded aggregate course used to support pervious pavement or in drainage zones in flow-through planters, vegetated stormwater facilities and infiltration galleries.

L. Growing media: Non-native soil mixture made up of sand, loam, and compost; used on surface stormwater facilities.

M. Unified Soil Classification System:

1. GW: Well-graded gravels; gravel/sand mixtures with little or no fines.
2. GP: Poorly-graded gravels; gravel/sand mixtures with little or no fines.

3. GM: Silty gravels; poorly-graded gravel/sand/silt mixtures.
4. GC: Clayey gravels; poorly-graded gravel/sand/clay mixtures.
5. SW: Well-graded sands' gravelly sands with little or no fines.
6. SP: Poorly-graded sands; gravelly sands with little or no fines.
7. SM: Silty sands; poorly, graded- sand/gravel/silt mixtures.
8. SC: Clayey sands; poorly-graded sand/gravel/clay mixtures.
9. ML: Inorganic silts; sandy, gravelly, or clayey silts.
10. CL: Lean clays; inorganic, gravelly, sandy, or silty, low to medium-plasticity clays.
11. OL: Organic, low-plasticity clays and silts.
12. MH: Inorganic, elastic silts; sandy, gravelly or clayey elastic silts
13. CH: Fat clays; high-plasticity, inorganic clays.
14. OH: Organic, medium to high-plasticity clays and silts
15. PT: Peat, humus, hydric soils with high organic content.

1.4 PROJECT CONDITIONS

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

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

C. Site Information: Research public utility records and verify existing utility locations prior to ordering any material. Notify the Architect immediately if any discrepancies are found in the project survey.

D. See Geotechnical report titled Geotechnical Engineering Report – Albany Waterfront Redevelopment by Geotechnics dated December 22, 2020 for additional information and requirements.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

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

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

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

E. Base Course: Use Oregon Standard Specifications for Construction 3/4-inch-0" BASE AGGREGATE.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 3-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Use Oregon Standard Specifications for Construction ¾-inch—0-inch BASE AGGREGATE.

H. Backfill and Fill:

1. Satisfactory soil materials
2. Initial trench backfill: Use OREGON STANDARD SPECIFICATIONS FOR CONSTRUCTION 3/4-inch – 0-inch base aggregate.

I. Drainage Fill: Angular, granular material with a maximum particle size of 2 inches and shall meet Oregon Standard Specification 00430.11. The material shall be free of roots, organic material, and other unsuitable materials; have less than 2 percent passing the No. 200 sieve (washed analysis); and have at least two mechanically fractured faces.

J. Growing Media: A loose and friable material blend of loamy soil, sand and compost that is 30-40 percent compost (by volume) and meets the following other criteria:

1. Particle Gradation: A sieve analysis of the complete blended material shall be conducted per ASTM C117/C136, AASHTO T11/T27, or ASTM D422/D140 and meet the following gradation criteria:

Sieve Size	Percent Passing
1-inch	100
#4	75-100
#10	40-100
#40	15-50
#100	5-25
#200	5-15

The blend shall have a coefficient of uniformity (D60/D10) equal to or greater than 6 to ensure it is well graded.

2. Acidity: pH of the blended material shall be tested and be between 6 and 8.
3. Compost: The compost shall be derived from plant material and provided by a member of the US Composting Council Seal of Testing Assurance (STA) program. See www.compostingcouncil.org for a list of local providers. The compost shall be a result of biological degradation and transformation of plant-derived materials under conditions designed to promote aerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have no visible free water and produce no dust when handled. It shall meet the following criteria, as reported by the US Composting Council STA Compost Technical Data Sheet provided by the vendor.

a. 100 percent of the material must pass through a ½ inch screen.
b. The pH of the material shall be between 6 and 8.
c. Manufactured inert material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0 percent by weight.
d. The organic matter content shall be between 30 and 70 percent (dry weight basis).
e. Soluble salt content shall be less than 6.0 mmhos/cm.
f. Maturity indicator shall be greater than 80 percent for Germination and Vigor.
g. Stability shall be 'Stable' to 'Very Stable'.
h. Carbon/Nitrogen (C/N) ratio shall be less than 25:1.
i. Trace metals test result= 'Pass.'

4. Blend: The material shall be well mixed and homogenous. It shall be free of wood pieces, plastics, and other foreign matter. There shall be no visible free water.
5. Infiltration: The blended material shall have a minimum infiltration rate of [2] inches per hour. Contractor shall provide the Engineer with a 2 quart sample for initial testing.

K. Controlled Density Fill (CDF), also referred to as "Controlled Low Strength Material (CLSM): Highly flowable, lean concrete mix of fly ash, cement, fine aggregates, water and admixtures meeting the following other criteria:

1. Portland Cement: ASTM C150, Type I or II.
2. Aggregates: Non-expansive or reactive with 100 percent passing a 3/8-inch sieve and less than 10 percent passing the No. 200 sieve. Aggregates shall meet the requirements of ASTM C33.
3. Fly ash: Conform to ASTM C618, Class F unless otherwise approved.
4. Water: Potable.
5. Admixtures: As necessary to improve flowability without segregation.
6. Compressive Strength: CDF shall attain a 28-day compressive strength of 100 psi – 200 psi.

2.2 ACCESSORIES

A. 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 or as follows:

1. Red: electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Tracer Wire: 12 AWG minimum solid copper insulated High Molecular Weight Polyethylene (HMW PE) tracer wire or approved equal. The tracer wire insulation shall be green for sewer pipe and blue for waterlines and be a minimum of 45 mil. thick. Joints or splices shall be waterproof. The wire shall be rated for 30 Volt.

C. Impermeable liner: PVC or HDPE Geo-membrane textured on both sides, 30 mil (.076mm) minimum.

D. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 110 lbf ; ASTM D 4632.
2. Tear Strength: 40 lbf ; ASTM D 4533.
3. Puncture Strength: 220 lbf ; ASTM D 4833.
4. Apparent Opening Size: No. 40 ; ASTM D 4751.
5. Permativity (minimum): .5 sec^{-1}; ASTM D 4491.

E. Separation Fabric: Woven geotextile, specifically manufactured as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 180 lbf ; ASTM D 4632.
2. Tear Strength: 68 lbf ; ASTM D 4533.
3. Puncture Strength: 371 lbf ; ASTM D 4833.
4. Apparent opening size: No. 30; ASTM D 4751.

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. Provide protective insulating materials as necessary.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section “Site Clearing.”

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section “Erosion and Sediment Control” during earth moving operations.

D. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

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

F. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

G. Protect all areas designated to be infiltration facilities from foot or equipment traffic and surface water runoff. Do not use proposed infiltration facilities to dispose of surface water runoff during construction. Under no circumstances shall material and equipment be stored on top of the

installation area. Contractor shall not backfill facility until Engineer has inspected it and signed off.

H. Protect all areas designated to receive pervious pavers or pervious pavement from excessive compaction.

3.2 EXPLOSIVES

1. Explosives: Do not use explosives.

3.3 EXCAVATION

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 without prior approval by the Architect.

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

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.6 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: 6 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 and bedding course 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. Hand excavate for bell of pipes.

2. Excavate utility structures to provide 6 inches clearance (enlarge as needed) to allow for compaction of backfill material.

3.7 EXCAVATION FOR STORMWATER INFILTRATION FACILITIES

A. Excavate facilities to the indicated gradients, lines, depths, and elevations. All excavations shall be performed with the lightest practical excavation equipment. Excavation equipment shall not be operated within the limits of the facility.

B. To help prevent subgrade soil contamination and clogging by sediment, facility construction shall be delayed until all other construction within its drainage basin is completed and the drainage area stabilized. Provide additional sediment control measures such as diversion berms around the facility as needed. Additional excavation and backfill required to restore any infiltration rate lost due to clogging or over-compaction during construction shall be performed by the contractor at no cost to the owner.

3.8 SUBGRADE INSPECTION

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

B. Soft pockets and areas of excess yielding that have been identified shall be scarified and moistened or aerated, or removed and replaced with suitable soil materials to the depth required. Re-compact and retest until specified compaction is obtained.

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

3.9 UNAUTHORIZED EXCAVATION

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

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

3.10 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.

3.11 BACKFILLS AND FILLS

A. Backfill: Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BEDDING

A. Place bedding 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.

3.13 UTILITY TRENCH BACKFILL

A. Trenches under Footings: Backfill trenches excavated under footings with satisfactory soil or approved backfill to within 18 inches from the bottom of footings elevation; fill remaining trench excavation with concrete up to the elevation of bottom of footings. Concrete is specified in "Cast-in-Place Concrete."

B. Place and compact initial trench backfill material, 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.

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

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

E. Install tracer wire in a continuous fashion above the utility in such a manner as to be able to properly trace utility lines without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire. Bring tracer wire to the surface at every box, vault, drainage structure, or manhole.

3.14 DRAINAGE FILL

A. Compaction of the native soil subgrade should be limited in order to prevent a reduction in the permeability of the soil.

1. Where erosion of subgrade has caused accumulation of fine materials and/or surface ponding, this material shall be removed with light equipment and underlying soils scarified to a minimum depth of 3 inches with a York rake or equivalent and light tractor.
2. Where subgrade has been compacted due to construction traffic, subgrade shall be scarified or removed to a depth sufficient to match the naturally occurring insitu state. Add additional base course material to meet design grades at no cost to the owner.
3. Bring subgrade of base course to line, grade, and elevations indicated. Fill and lightly re-grade any areas damaged by erosion, ponding, or traffic compaction before the placing of stone.

B. Place drainage geotextile over prepared subgrade, overlapping ends and edges at least 12 inches. Secure in place to prevent wrinkling.

C. Place drainage fill and compact by tamping with a plate vibrator, and screed to depth indicated. For drainage fill that exceeds 8 inches in compacted thickness, place fill in layers of equal thickness, with no compacted layer more than 8 inches or less than 4 inches thick.

D. Place drainage geotextile over compacted drainage fill, overlapping ends and edges at least 12 inches.

3.15 SOIL FILL

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

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.
6. Under and around utility structures, use engineered fill.

3.16 STORMWATER INFILTRATION FACILITY FILL

A. Growing media shall be placed in loose lifts, not to exceed 8 inches each.

B. Placement of the growing media will not be allowed when the weather is too wet as determined by the owner's representative.

3.17 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 3 percent and is too wet to compact to specified dry unit weight.

3.18 COMPACTION OF SOIL BACKFILLS AND FILLS

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

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

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 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 95 percent.

D. Growing media shall be compacted with a water-filled landscape roller. It shall not otherwise be mechanically compacted.

3.19 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 1/2 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.20 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

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

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

1. Shape subbase course and base course to required crown elevations and cross-slope grades.
2. Place subbase course and base 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 and base 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.

3.21 FIELD QUALITY CONTROL

A. Testing Agency: Contractor 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. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing Agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and building slab areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.

E. With the approval of the Engineer, proof-roll testing of subgrade and/or aggregate base may be substituted for other compaction testing.

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

3.22 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.

D. Weather permitting and as approved, stormwater infiltration facility plants shall be installed as soon as possible after placing and grading the growing media in order to minimize erosion and further compaction.

3.23 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 31 2000

SECTION 31 25 00 - TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SUMMARY:

A. This section includes the following:

1. Prevention of erosion due to construction activities.
2. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

1.2 PERFORMANCE REQUIREMENTS

A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), under requirements for the 2012 General Permit for Discharges from Construction Activities.

B. Also comply with all more stringent requirements of State of Oregon Erosion and Sedimentation Control Manual.

C. Follow an Erosion and Sedimentation Control Plan.

D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.

E. Revisions to ESCP: Keep copies of all ESCP revisions on site. There are three ways to inform DEQ or an Agent of revisions to the ESCP:

- Submit ESCP revisions by email to DEQ or its Agent when revisions to the ESCP are minimal and identify in the email the particular changes. Submit only portions of the ESCP that have changed.
- Submit the revisions by redlining the copy of the original ESCP or drawings. Submit only drawings that have changes.
- When the ESCP requires extensive revisions, submit the entire revised ESCP to DEQ.

ESCP revisions must be submitted to DEQ if they are made for any of the reasons listed below:

1. Changes for emergency situations: When immediate corrective actions are required to cease the discharge of significant amounts of sediment entering surface waters or nearby properties, the ESCP revisions must identify the corrective actions taken to cease the discharge, if such actions require a change to the ESCP or a change in the method(s) of implementing the ESCP, (for example, increased inspection frequency). Submit the ESCP to DEQ within ten calendar days of the discharge

identifying the corrective actions taken to cease the discharge. Approval of the revisions by DEQ or its Agent prior to implementation of corrective actions is not required.

2. Change (increase or decrease) in the size of the project: Submit revisions to DEQ or its Agent at least 10 days before implementing the revisions. If the permit registrant does not receive a response from DEQ or its Agent within 10 days of receipt, the proposed revisions are deemed approved.
3. Change (increase or decrease) in the size or location of disturbed areas: Submit revisions to DEQ or its agent at least 10 days before implementing the revisions. If the permit registrant does not receive a response from DEQ or its Agent within 10 days of the receipt, the proposed revisions are deemed approved.
4. Changes to BMPs: Submit changes in the project design that may affect stormwater discharges, local conditions, or project schedule (for example, schedule delays postpone earthwork to wet weather season so additional controls are needed) must be submitted. In addition, submit changes (such as type or design) to the BMPs identified in the ESCP, their location, maintenance required, and any other revisions necessary to prevent and control erosion and sediment runoff. Submit revisions to DEQ or its Agent at least 10 days before implementing the revisions. If the permit registrant does not receive a response within 10 days of receipt, the proposed revisions are deemed approved.
5. Change in the erosion and sediment control inspector: Submit name, contact information, and qualifications to DEQ or its Agent. If the permit registrant does not receive a response from DEQ or its Agent within 10 days of receipt, the inspector(s) are deemed approved.
6. Changes that DEQ or Agent requests: DEQ or Agent may require the permit registrant to submit ESCP revisions at any time if the ESCP is inadequate to prevent the discharge of significant amounts of sediment or turbidity to surface waters or to conveyance systems that discharge to surface waters.

F. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.

1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.

H. Inspections:

1. Inspections must be conducted by a person who:

a. Is knowledgeable in the principle and practice of erosion and sediment controls, and
b. Possesses the skills to assess conditions at the construction site that could impact stormwater quality, and
c. Is knowledgeable in the correct installation of the erosion and sediment controls, and

d. Is able to assess the effectiveness of sediment and erosion control measures selected to control the quality of stormwater discharges from the construction activity.

2. Visual monitoring requirement: all areas of the site disturbed by construction activity must be inspected to ensure that BMPs are in working order. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site sediment tracking as well as areas used for storage of materials that are exposed to precipitation for evidence of spillage or other potential to contaminate stormwater runoff. In addition, inspect all discharge points identified in the ESCP for evidence of or the potential for the discharge of pollutants, and to ascertain whether erosion and sediment control measures are effective in preventing significant impacts to surface waters. Where discharge points are inaccessible, nearby downstream locations must be inspected to the extent that such inspections are practicable.
3. All ESCP controls and practices must be inspected according to the following schedule:

Site Condition	Minimum Frequency
1. Active Period	Daily when stormwater runoff, including runoff from snowmelt, is occurring. At least once every two weeks, regardless of whether stormwater runoff is occurring.
2. Prior to the site becoming inactive or in anticipation of site inaccessibility	Once to ensure that erosion and sediment control measures are in working order. Any necessary maintenance and repair must be made prior to leaving the site.
3. Inactive periods greater than 14 consecutive calendar days	Once every 2 weeks.
4. Periods during which the site is inaccessible due to inclement weather	If practical, inspections must occur daily at a relevant and accessible discharge point or downstream location

4. Recordkeeping Requirements: Document all visual inspections in an onsite logbook. If there are no findings, simply record the inspection date, and inspector's name. In addition, record any findings, including:

a. At the designated discharge location(s):

1) Where to make observations:

a) At the discharge location if the discharge is to a conveyance system leading to surface waters;
b) From the discharge point to 50 feet downstream if the discharge is to surface waters; and
c) At any location where more than 1/2 of the width of the receiving surface water is affected.

2) How to make observations:

a) For turbidity and color, describe any apparent color and the clarity of the discharge, and any apparent difference in comparison with surface waters.
b) Describe any sheen or floating material, or record that it is absent. If present, it could indicate concern about a possible spill or leakage from vehicles or materials storage.

b. If a site is inaccessible due to inclement weather, record the inspections noted at a relevant discharge point or downstream location, if practical.
c. Locations of BMPs that need to be maintained, inspections of all BMPs, including erosion and sediment controls, chemical and waste controls, locations where vehicles enter and exit the site, status of areas that employ temporary or final stabilization control, soil stockpile area, and non-stormwater pollution (e.g. paints, oils, fuels, adhesives) controls.
d. Locations of BMPs that failed to operate as designed or proved inadequate for a particular location;
e. Locations where additional BMPs are needed that did not exist at the time of inspection; and
f. Corrective action required and implementation dates.
g. All inspection records and monitoring results must be kept on site and maintained by the permit registrant. The records shall list the construction site name as it appears on the registrant's permit and the file or site number. These records must be made available to DEQ, Agent, or local municipality upon request. These records must be delivered or made available to DEQ within 3 working days of request. These inspection records and monitoring results must be maintained for at least 3 years after project completion. In addition, a copy of the ESCP and revisions must be retained on site and made available on request to the DEQ, Agent, or the local municipality. During inactive periods of greater than 7 consecutive calendar days, the ESCP must be retained by the permit registrant but does not need to be at the construction site.

I. Erosion On-Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.

1. Control movement of sediment and soil from temporary stockpiles of soil.
2. Prevent development of ruts due to equipment and vehicular traffic.
3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

J. Erosion Off-Site: Prevent erosion of soil and deposition of sediment on other properties due to construction activities for this project.

1. Prevent windblown soil from leaving the project site.
2. Prevent tracking of mud onto public roads outside site.
3. Prevent mud and sediment from flowing onto sidewalks and pavements.
4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

K. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.

1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
2. If sediment basins are used as temporary preventive measures pump dry and remove deposited sediment after each storm.

L. Sedimentation of Waterways Off-Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.

1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

M. Open Water: Prevent standing water that could become stagnant.

N. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.3 SUBMITTALS

A. Product Data: For materials indicated in ESCP and additional materials included in ESCP revisions.

B. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wattles: Straw-filled tube of flexible netting.

1. Straw must be certified weed free forage.
2. Netting to consist of seamless, high density polyethylene and ethyl vinyl acetate and contain ultra-violet inhibitors.

B. Bio-filtration Bags: Bark or woodchip filled bag of flexible netting.

1. Fill material shall be clean, 100 percent recycled wood or compost product.
2. Bags shall be made of nylon mesh.

C. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; with the following properties:

1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D 4751.

2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D 4491.
3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D 4355 after 500 hours exposure.
4. Tensile Strength: 100 lb-f, minimum, in cross-machine direction; 124 lb-f, minimum, in machine direction; when tested in accordance with ASTM D 4632.
5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D 4632.
6. Tear Strength: 55 lb-f, minimum, when tested in accordance with ASTM D 4533.
7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.

D. Silt Fence Posts: One of the following, minimum 4 feet long:

1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.
2. Softwood, 4 by 4 inches in cross-section.
3. Hardwood, 2 by 2 inches in cross-section.

E. Gravel: As called out on the details.

F. Inlet protection filter sack: as shown on plans.

G. Sediment curtains

H. Flocculants: Chemical used to aid settling of small particles.

1. Product Manufacturers:

a. Stormklear GelFloc
b. Or approved equal.

I. Erosion Control Blankets: as shown on plans.

J. Compost Socks: Mixed yard debris compost-filled tube of synthetic or cotton fiber.

K. Concrete Washout Container: Temporary containment system for cementitious material wash-outs.

1. Product Manufacturers:

a. Eco-Pan
b. Or approved equal.

L. Concrete Wash-out Pit: As shown on Plans.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.2 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.3 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.

1. Width: As required; twenty (20) feet, minimum.
2. Length: fifty (50) feet, minimum.
3. Provide at each construction entrance from public right-of-way.
4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences, wattles, or compost socks.

1. Provide linear sediment barriers:

a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.

2. Space sediment barriers with the following maximum slope length upslope from barrier:

a. Slope of Less Than 2 Percent: 100 feet.
b. Slope Between 2 and 5 Percent: 75 feet.
c. Slope Between 5 and 10 Percent: 50 feet.
d. Slope Between 10 and 20 Percent: 25 feet.
e. Slope Over 20 Percent: 15 feet.

D. Inlet Protection Filter Sack: Protect each inlet using the following measures:

1. Woven fabric bag insert set beneath inlet grate.
2. Bio-filtration bags blocking entire inlet face area.

E. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.

F. Soil Stockpiles: Protect using one of the following measures:

1. Cover with polyethylene film, secured by placing soil or sand bags on outer edges.
2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves; or, 6 inches of straw or hay;

a. as approved by Owner’s Representative.

G. Temporary Seeding: Use where temporary vegetated cover is required.

H. Concrete Wash-out Container: Use when there is not sufficient space for a traditional concrete wash-out pit.

I. Concrete Wash-out Pit: Size as required to handle estimated concrete usage.

3.4 INSTALLATION

A. Temporary Traffic-Bearing Aggregate Surface:

1. Excavate minimum of 6 inches.
2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
3. Place and compact at least 6 inches of 1.5 to 3.5 inch diameter stone.

B. Silt Fences:

1. Store and handle fabric in accordance with ASTM D 4873.
2. Use nominal 36 inch high barriers with minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
3. Install with top of fabric at nominal height and embedment as specified.
4. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
5. Fasten fabric to wood posts using one of the following:

    a. Integral pockets.
    b. Four 3/4 inch diameter, 1 inch long, 14 gage nails.
    c. Five 17-gage staples with 3/4 inch wide crown and 1/2 inch legs.

6. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
7. Wherever runoff will flow around end of barrier, provide temporary splash pad or other outlet protection.

C. Bio-Filter Bag:

1. Install bags in continuous rows with ends butting tightly, with one bag at each end of row turned uphill.
2. Anchor bags with at least two stakes per bag, into the ground.

D. Inlet Protection Filter Sack:

1. Install per manufacturer’s recommendations.

E. Wattles

1. Install wattles in 3-5-inch minimum deep trench that is constructed along the contour, perpendicular to the slope or direction of flow.
2. Embed wattle with a 1-inch by 1-inch hardwood stake every 4 lineal feet, driven at least 18 inches into the ground. A stake shall be placed within two feet of the end of the wattle.
3. Adjacent rolls shall tightly abut.

F. Concrete Wash-out Container:

1. Install per manufacturer's recommendations on level ground.

G. Concrete Wash-out Pit:

1. Install as shown on Plans.

3.5 MAINTENANCE

A. Inspect preventive measures routinely (daily), within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.

B. Repair deficiencies immediately.

C. Silt Fences:

1. Promptly replace fabric that deteriorates unless need for fence has passed.
2. Remove silt deposits that exceed one-third of the height of the fence.
3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Bio-Filtration Bags:

1. Promptly replace bags that fall apart or otherwise deteriorate unless need has passed.
2. Remove silt deposits that exceed one-half of the height of the bags.
3. Repair bag rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

E. Inlet Protection Filter Sacks

1. Promptly replace sacks that are damaged or deteriorated unless the need has passed.
2. Remove silt deposits that exceed the containment area of the sack.

F. Wattle Rows:

1. Promptly replace wattles that fall apart or otherwise deteriorate unless need has passed.
2. Remove silt deposits that exceed one-half of the height of the wattles.
3. Repair wattles that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

G. Clean out temporary sediment control structures weekly and relocate soil on site.

H. Place sediment in appropriate locations on site; do not remove from site.

I. Concrete Wash-out Container: Properly call container provider to pick up pan when full and replace with empty pan or properly disopose of concrete waste material. Concrete waste to be recycled by container provider.

3.6 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Owners Representative.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION 31 2500

SECTION 31 66 00 – HELICAL PILE FOUNDATION

PART 1 - GENERAL

1.1 PURPOSE OF SPECIFICATION

A. The purpose of this specification is to detail the furnishing of all designs, materials, tools, equipment, labor and supervision, and installation techniques necessary to install Helical Piles as detailed on the drawings, including connection details. This shall include provisions for load testing that may be part of the scope of work

1.2 SCOPE OF WORK

A. This work consists of furnishing all necessary engineering and design services, supervision, labor, tools, materials, and equipment to perform all work necessary to engineer and install the Helical Piles, described herein, and as shown on the drawings. The Contractor shall engineer and install a Helical Pile that will develop the load capacities as detailed on the drawings. This may also include provisions for load testing to verify Helical Pile capacity and defection, if part of the scope of work.

1.3 QUALIFICATIONS OF HELICAL PILE CONTRACTOR

A. The Helical Pile Contractor shall be experienced in performing design and construction of Helical Piles and shall furnish all materials, labor, and supervision to perform the work.

1.4 DEFINITIONS

A partial list follows. The Project Manager may wish to add other specific, project-related items.

A. **Contractor:** The person/firm responsible for performing the Helical Pile work.

B. **Coupling:** Central steel shaft connection means formed as integral part of the plain extension shaft material. For Type SS & RS Helical Piles, couplings are internal or external sleeves, or hot upset forged sockets.

C. **Coupling Bolt(s):** High strength, structural steel fasteners used to connect Helical Pile segments together. For Type SS segments, the coupling bolt transfers axial load. For Type RS segments, the coupling bolts transfer both axial and torsional forces.

D. **Helical Extension:** Helical Pile foundation component installed immediately following the lead or starter section, if required. This component consists of one or more helical plates welded to a central steel shaft of finite length. Function is to increase bearing area.

E. **Helix Plate:** Generally round steel plate formed into a ramped spiral. The helical shape provides the means to install the helical pile, plus the plate transfers load to soil in end bearing. Helix plates are available in various diameters and thickness.

F. **Helical Pile:** A bearing type foundation element consisting of a lead or starter section, helical extension (if so required by site conditions), plain extension section(s), and a pile cap. A.k.a. helical screw pile, screw pile, helical screw foundation.

G. **Installation Torque(T):** The resistance generated by a Helical Pile when installed into soil. The installation resistance is a function of the soil type, and size and shape of the various components of the Helical Pile.

H. **Lead Section:** The first Helical Pile foundation component installed into the soil, consisting of single or multiple helix plates welded to a central steel shaft. A.k.a. Starter Section.

I. **Pile Cap:** Connection means by which structural loads are transferred to the Helical Pile. The type of connection varies depending upon the requirements of the project and type of Helical Pile material used.

J. **Round Shaft (RS):** Round steel pipe central Shaft elements ranging in diameter from 2-7/8" to 10". A.k.a. Hollow Shaft (Type HS), Type T/C, Type PIF.

K. **Plain Extension:** Central steel shaft segment without helix plates. It is installed following the installation of the lead section or helical extension (if used). The segments are connected with integral couplings and bolts. Plain extensions are used to extend the helix plates beyond the specified minimum depth and into competent load bearing stratum.

L. **Safety Factor:** The ratio of the ultimate capacity to the working or design load used for the design of any structural element.

M. **Square Shaft (SS):** Solid steel, round-cornered-Square central Shaft elements ranging in size from 1-1/4" to 2-1/4". A.k.a. Type SQ.

N. **Torque Strength Rating:** The maximum torque energy that can be applied to the helical pile foundation during installation in soil, a.k.a. allowable, or safe torque.

1.5 ALLOWABLE TOLERANCES

The tolerances quoted in this section are suggested maximums. The actual values established for a particular project will depend on the structural application.

A. Centerline of Helical Piles shall not be more than 2 inches from indicated plan location.

B. Helical Pile plumbness shall be within 2° of design alignment.

C. Top elevation of Helical Pile shall be within +1 inch to –2 inches of the design vertical elevation.

1.6 QUALITY ASSURANCE

A. The Contractor shall employ an adequate number of skilled workers who are experienced in the necessary crafts and who are familiar with the specified requirements and methods needed for proper performance of the work of this specification.

B. All Helical Piles shall be installed in the presence of a designated representative of the Project Manager unless said representative informs the Contractor otherwise. The designated representative shall have the right of access to any and all field installation records and test reports.

C. Helical Pile components as specified therein shall be manufactured by a facility whose quality systems comply with ISO (International Organization of Standards) 9001 requirements. Certificates of Registration denoting ISO Standards Number shall be presented upon request to the Project Manager or their representative.

D. Design of Helical Piles shall be performed by an entity as required in accordance with existing local code requirements or established local practices. This design work shall be performed by a licensed professional engineer, registered in the state of Oregon.

1.7 DESIGN CRITERIA

A. Helical Piles shall be designed to meet the specified loads and acceptance criteria as shown on the drawings. The calculations and drawings required from the Contractor or Engineer shall be submitted to the Project Manager for review and acceptance in accordance to Section 3.1 “Construction Submittals”.

B. Lateral Load and Bending: Where Helical Piles are subjected to lateral or base shear loads as indicated on the plans, the bending moment from said loads shall be determined using lateral load analysis program such as LPILE or equal commercially available software. The required soil parameters (c, φ, γ, and ks) for use with LPILE or equal shall be provided in the geotechnical reports. The combined bending and axial load factor of safety of the Helical Pile shall be as determined by the Project Manager.

C. Critical Buckling Load: the critical buckling load shall be determined using lateral load analysis program such as LPILE or equal commercially available software, or various other methods. The required soil parameters (c, φ, γ, and ks) for use with LPILE or equal shall be provided in the geotechnical reports.

D. The Helical Pile attachment (pile cap) shall distribute the design load (DL) to the concrete foundation such that the concrete bearing stress does not exceed those in the ACI Building Code and the stresses in the steel plates/welds does not exceed AISC allowable stresses for steel members.

E. Corrosion Protection
   1. **Service Life:** a typical service life of 50 years should be used

1.8 GROUND CONDITIONS

A. The Geotechnical Report, including logs of soil borings as shown on the boring location plan, shall be considered to be representative of the in-situ subsurface conditions likely to be encountered on the project site. Said Geotechnical Report shall be the used as the basis for Helical Pile design using generally accepted engineering judgement and methods.

PART 2 - REFERENCED CODES AND STANDARDS

Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation. In case of conflict, the particular requirements of this specification shall prevail. The latest publication as of the issue of this specification shall govern, unless indicated otherwise.

2.1 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

A. ASTM A29/A29M Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished.

B. ASTM A36/A36M Structural Steel.

C. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

D. ASTM A153 Zinc Coating (Hot Dip) on Iron and Steel Hardware.

E. ASTM A252 Welded and Seamless Steel Pipe Piles.

F. ASTM A775 Electrostatic Epoxy Coating

G. ASTM A193/A193M Alloy-Steel and Stainless-Steel Bolting Materials for High Temperature Service.

H. ASTM A320/A320M Alloy-Steel Bolting Materials for Low Temperature Service.

I. ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

J. ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

K. ASTM A513 Standard Specification for Electric Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

L. ASTM A536 Standard Specifications for Ductile Iron Castings

M. ASTM A572 HSLA Columbium-Vanadium Steels of Structural Quality.

N. ASTM A618 Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.

O. ASTM A656 Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability.

P. ASTM A958 Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Wrought Grades.

Q. ASTM A1018 Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability.

R. ASTM D1143 Method of Testing Piles Under Static Axial Compressive Load.

S. ASTM D3689 Method of Testing Individual Piles Under Static Axial Tensile Load.

2.2 AMERICAN WELDING SOCIETY (AWS):

A. AWS D1.1 Structural Welding Code – Steel.

B. AWS D1.2 Structural Welding Code – Reinforcing Steel.

2.3 AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE):

A. ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations.

2.4 DEEP FOUNDATIONS INSTITUTE (DFI):

A. *Guide to Drafting a Specification for High Capacity Drilled and Grouted Micropiles for Structural Support*, 1st Edition, Copyright 2001 by the Deep Foundation Institute (DFI).

2.5 SOCIETY OF AUTOMOTIVE ENGINEERS (SAE):

A. SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners.

PART 3 - SUBMITTALS

3.1 CONSTRUCTION SUBMITTALS

A. The Contractor or Engineer shall prepare and submit to the Project Manager, for review and approval, working drawings and design calculations for the Helical Piles intended for use at least 14 calendar days prior to planned start of construction (but note also Paragraph 3.1.8). All submittals shall be signed and sealed by a Registered Professional Engineer currently licensed in the State/Province of Oregon.

B. The Contractor shall submit a detailed description of the construction procedures proposed for use to the Project Manager for review. This shall include a list of major equipment to be used.

C. The Working Drawings shall include the following:
1. Helical Pile number, location and pattern by assigned identification number
2. Helical Pile design load
3. Type and size of central steel shaft
4. Helix configuration (number and diameter of helix plates)
5. Minimum effective installation torque

6. Minimum overall length
7. Inclination of Helical Pile
8. Cut-off elevation
9. Helical Pile attachment to structure relative to grade beam, column pad, pile cap, etc.

D. The Contractor shall submit shop drawings for all Helical Pile components, including corrosion protection and pile top attachment to the Project Manager for review and approval. This includes Helical Pile lead/starter and extension section identification (manufacturer's catalog numbers).

E. If required, the Contractor shall submit certified mill test reports for the central steel shaft, as the material is delivered, to the Project Manager for record purposes. The ultimate strength, yield strength, % elongation, and chemistry composition shall be provided.

F. The Contractor shall submit to the Project Manager copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within forty-five (45) working days of the date submitted. Helical Pile installation and testing shall not proceed until the Project Manager has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:
1. Name of project and Contractor
2. Name of testing agency
3. Identification (serial number) of device calibrated
4. Description of calibrated testing equipment
5. Date of calibration
6. Calibration data

G. Work shall not begin until all the submittals have been received and approved by the Project Manager. The Contractor shall allow the Project Manager a reasonable time to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

3.2 INSTALLATION RECORDS

The Contractor shall provide the Project Manager copies of Helical Pile installation records within 24 hours after each installation is completed. Records shall be prepared in accordance with the specified division of responsibilities as noted in Table-1. Formal copies shall be submitted on a weekly basis. These installation records shall include, but are not limited to, the following information.

A. Name of project and Contractor

B. Name of Contractor's supervisor during installation

C. Date and time of installation

D. Name and model of installation equipment

E. Type of torque indicator used

F. Location of Helical Pile by assigned identification number

G. Actual Helical Pile type and configuration – including lead section (number and size of helix plates), number and type of extension sections (manufacturer's SKU numbers)

H. Helical Pile installation duration and observations

I. Total length of installed Helical Pile

J. Cut-off elevation

K. Inclination of Helical Pile

L. Installation torque at one-foot intervals for the final 10 feet

M. Comments pertaining to interruptions, obstructions, or other relevant information

N. Rated load capacities

3.3 TEST REPORTS

The Contractor shall provide the Project Manager copies of field test reports within 24 hours after completion of the load tests. Records shall be prepared in accordance with the specified division of responsibilities as noted in Table-1. Formal copies shall be submitted within a reasonable amount of time following test completion. These test reports shall include, but are not limited to, the following information (note Section 6 – Helical Pile Load Tests).

A. Name of project and Contractor

B. Name of Contractor's supervisor during installation

C. Name of third-party test agency, if required

D. Date, time, and duration of test

E. Location of Helical Pile by assigned identification number

F. Type of test (i.e. tension or compression)

G. Description of calibrated testing equipment and test set-up

H. Actual Helical Pile type and configuration – including lead section, number and type of extension sections (manufacturer's SKU numbers)

I. Steps and duration of each load increment

J. Cumulative pile-head movement at each load step

K. Comments pertaining to test procedure, equipment adjustments, or other relevant information

L. Signed by third party test agency rep., registered professional engineer, or as required by local jurisdiction

3.4 CLOSEOUT SUBMITTALS

A. Warranty: Warranty documents specified herein
   1. Project Warranty: Refer to Conditions of the Contract for project warranty provisions
      a. Warranty Period: (*Specify Term*) years commencing on date of Substantial Completion
   2. Manufacturer's Warranty: Submit, for Project Manager's Acceptance, manufacturer's standard warranty document executed by authorized company offcial. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Project Manager may have under Contract Document.

PART 4 - PRODUCTS AND MATERIALS

4.1 ALL STEEL MATERIALS

A. All materials shall be minimum ASTM A36 and shall be hot dipped galvanized or stainless steel

PART 5 - EXECUTION

5.1 SITE CONDITIONS

A. Prior to commencing Helical Pile installation, the Contractor shall inspect the work of all other trades and verify that all said work is completed to the point where Helical Piles may commence without restriction.

B. The Contractor shall verify that all Helical Piles may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.

C. In the event of a discrepancy, the Contractor shall notify the Project Manager. The Contractor shall not proceed with Helical Pile installation in areas of discrepancies until said discrepancies have been resolved. All costs associated with unresolved discrepancies shall be the responsibility of the Project Manager.

PART 6 - HELICAL PILE LOAD TESTS

6.1 PRODUCTION HELICAL PILE TESTING

A. The Contractor shall perform proof tests on a minimum of 4 production Helical Piles. The Helical Piles to be tested will be selected by the Project Manager. At the Contractor's suggestion, but with the Project Manager's permission, tension tests may be performed in lieu of compression tests up to 1.00 DL for Helical Piles with sufficient structural tension capacity.

The test sequence shall be as shown in Table-4 to the extent practical.

Table-4. Steps for Production Load Testing

LOAD STEP	HOLD TIME (MINUTES)
AL	0 Min.
0.20 DL	2.5 Min.
0.40 DL	2.5 Min.
0.60 DL	2.5 Min.
0.80 DL	2.5 Min.
1.00 DL	5 Min.
0.60 DL	1 Min.
0.40 DL	1 Min.
0.20 DL	1 Min.
AL	5 Min.

AL = Alignment Load; DL = Design Load

The acceptance criteria for production Helical Piles shall be per Section 6.4 Item 1.

If a production Helical Pile that is tested fails to meet the acceptance criteria, the Contractor shall be directed to proof test another Helical Pile in the vicinity. For failed Helical Piles and further construction of other foundations, the Contractor shall modify the design, the construction procedure, or both. These modifications include, but are not limited to, installing replacement Helical Piles, modifying the installation methods and equipment, increasing the minimum effective installation torque, changing the helix configuration, or changing the Helical Pile material (i.e., central steel shaft). Modifications that require changes to the structure shall have prior review and acceptance of the Project Manager. Any modifications of design or construction procedures shall be at the Contractor’s expense.

END OF SECTION 31 66 00

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 31 20 00 "Earth Moving" for subgrade preparation, fill material, aggregate subbase and base courses, and aggregate pavement shoulders.

1.2 SUBMITTALS

A. Product Data: For each type of product. 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.
2. Job-mix Designs: For each job mix proposed for the Work.

B. Material Certificates: For each paving material.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Section 0744 of the 2018 Oregon Standard Specifications for Construction for asphalt paving work.

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

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expect 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 and Surface Course:

Dense Graded Mixes	Surface Temperature

Less than 2 inches	60 degrees F
2 inches – 2 1/2 inches	50 degrees F
Greater than 2 1/2 inches	40 degrees F

3. If placing asphalt between March 15 and September 30, temperature may be lowered 5 degrees F.
4. Do not use field burners or other devices to heat the pavement to the specified minimum temperature.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil based materials and 55 deg F for water-based materials, and not exceeding 95 deg F .

C. Thermoplastic Pavement-Markings: Proceed with pavement markings only on clean, dry surfaces, minimum ambient or surface temperature shall be 50 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Conform to the requirements of 00744 of the 2015 Oregon Standard Specifications for Construction.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22 or PG 70-22.

B. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

C. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.

1. Color: As Indicated.

D. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: As Indicated.

E. Thermoplastic Pavement Markings: Type B-HS Pre-formed, fused thermoplastic film conformed to the requirements of 00867 of the 2015 Oregon Standard Specifications for Construction.

1. Color: White.

F. Wheel Stops: Precast, air-entrained concrete, 2500-psi (17.2 MPa) minimum compressive strength, 6 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, ¾ inch diameter, 10-inch minimum length.

G. Wheel Stops: Solid, integrally colored, 96 percent recycled HDPE or commingled postconsumer and postindustrial recycled plastic; UV stabilized 4 inches high by 6 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
1. Dowels: Galvanized Steel, ¾ inch diameter, 10-inch minimum length.

2.4 MIXES

A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent or more than 50 percent by weight.

1. Surface Course Limit: Recycled content no more than [30] <Insert number> percent by weight.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Provide mixes conforming to section 00744 of the 2018 Oregon Standard Specifications for Construction.

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

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply tack coat uniformly to vertical asphalt surfaces. Apply at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Asphalt and sand seal edges where new asphalt concrete meets existing pavement.

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

C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Spread mix at a minimum temperature of 250 deg F.
2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

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

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

D. Provide adequate lighting to illuminate the paver and the roadway in front of and behind the paver during the period from 30 minutes after sunset to 30 minutes before sunrise, or as deemed necessary by the Engineer. Provide a minimum light level of 10 foot-candles as measured on the paved surface at a distance of 16 feet from the front and back edge of the paver. Shield lighting from adjacent traffic and roadways as necessary.

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.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.6 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 or greater than 96 percent.

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

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

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

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

H. Provide adequate lighting to illuminate each roller and the roadway in front of and behind the roller during the period from 30 minutes after sunset to 30 minutes before sunrise, or as deemed necessary by the Engineer. Provide a minimum light level of 10 foot-candles as measured on the paved surface at a distance of 60 feet from the front and back edge of each roller. Shield lighting from adjacent traffic and roadways as necessary.

I. Compaction to a specified density will not be required for thin pavements such as leveling, patches, or where the nominal compacted thickness of a course of asphalt concrete pavement will be less than 2 inches.

3.7 INSTALLATION TOLERANCES

A. Cold Milling: Test with a 12-foot (3.7 meter) straightedge furnished and operated by the Contractor, as directed. The variation from the top of the ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed 1/4 inch .

B. 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.

C. 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. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.
4. Difference between adjacent panels: 1/8 inch .

3.8 PAVEMENT MARKING

A. Do not apply pavement-marking paint or thermoplastic material until layout, colors and placement have been verified with architect.

B. Allow paving to age for 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 .

1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal. .

E. Install thermoplastic pavement markings as indicated on the drawings per the requirements of section 00850 and 00867 of the 2015 Oregon Standard Specifications for Construction.

3.9 WHEEL STOPS

A. Install wheel stops with dowels.

3.10 CORRECTION OF DEFECTS

A. Correct all defects in materials and work at no additional cost to the owner, as follows:
   1. Fouled Surfaces: Immediately repair, clean, and re-tack fouled surfaces that would prevent full bond between successive lifts of mixture.
   2. Boils, Slicks, and Oversized Material: Immediately remove and replace boils, slicks, and oversized materials with fresh mixture.
   3. Segregation: Take immediate corrective measures when segregation or non-uniform surface texture is occurring in the finished mat. If segregation continues to occur, stop production until a plan for providing uniform surface texture is approved by the Port.
   4. Roller Damage to the Surface: Immediately correct surface damage from rollers with additional fresh mixture or by other means approved by the owner.
   5. Longitudinal Joints: Take immediate corrective measures when open longitudinal joints are being constructed or when the elevation of the two sides of a longitudinal joint does not match. If problems with the longitudinal joint continue to occur, stop production until a plan for providing tight, equal elevation longitudinal joints is approved by the owner.
   6. Corrective Measures: Take immediate corrective measures when the specified compaction density is not being achieved.
   7. Other Defects: Remove and replace any HMAC that:
      a. Is loose, broken, or mixed with dirt.
      b. Visually shows too much or too little asphalt.
      c. Is defective in any way.

3.11 FIELD QUALITY CONTROL

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

B. Verify density by random testing of the compacted surface with calibrated nuclear gauges. Determine the density by averaging QC tests performed by a Certified Density Technician (CDT) with the nuclear gauge operated in the backscatter mode according to AASHTO T 335 at one random location for each 100 tons of asphalt concrete placed, but take no less than 10 tests per shift. Do not locate the center of a density test less than 1 foot from the panel edge. Calculate the Moving Average Maximum Density (MAMD) according to ODOT TM 305.

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

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

3.12 WASTE HANDLING

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 32 1216

SECTION 32 1313 – CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Walkways.
2. Stepped walkway.
3. Splash pad.
4. Concrete pads below site furnishingsCurbs and gutters.
5. Unit paver base.
6. Rubberized surfacing base.
7. Driveways
8. Light pole collars
9. Concrete slabs .
10. ADA detectable warning tile.

B. Related Sections include the following:

1. Division 31 Section “Earth Moving” for subgrade preparation, grading, base course, and subbase course.
2. Division 03 Section "Misc. Cast-in-Place Concrete" for concrete stairs, concrete bases, walls, wall substrates, and footings.
3. Division 32 Section “Unit Paving” for precast concrete pavers.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other Pozzolans, and ground granulated blast-furnace slag.

1.3 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Samples:
1. Joint Filler Material: Submit one 12-inch length.
2. Elastomeric Joint Sealant: Submit actual sample in 12-inch length.
3. Aggregates for Concrete Mix: Submit 1/2 cubic foot sack of actual aggregates to be used in concrete mix for surface retarded (exposed aggregate) paving.
4. Silica sand: submit 1 quart Ziploc bag.
5. Manufacturer’s 8 inch by 8 inch samples of integral colors indicated at full strength, half strength, and quarter strength, with surface retarded finish on one half of the

sample and broom finish on the other half, and clear sealer on lower half for each color selected by the Architect.

6. Manufacturer’s 8 inch by 8 inch samples of matching color tinted sealant on one half of specified colored concrete with clear sealer on lower half for each color selected by the Architect.

C. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Shop Drawings: Include details of steel reinforcement placement including material, grade, bar schedules, spacing, bent bar diagrams, arrangement, and supports. Provide plans and details for each paving section.

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

F. Field quality-control test reports.

G. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94 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 ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

C. Standard Specifications: Perform site concrete Work in compliance with the latest edition of the "Standard Specifications for Construction” prepared by Oregon Department of Transportation (ODOT). Comply with the more stringent of the ODOT Sections of Part 02000 and applicable Special Provisions or the ASTM Standards listed below.

D. Concrete Testing Service: Owner will engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

E. Mockups: Cast mockups of full-size sections (5’x5’ minimum) of each specified concrete pavement color and finish to demonstrate typical joints, surface finish, texture, color, sealant and silica sand installation and general standard of workmanship.

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Owner's Representative.
2. Notify Owner's Representative seven days in advance of dates and times when mockups will be constructed.

3. Provide examples of each type of jointing identified on the drawings. Jointing layout and intersections should be identical to the angles indicated on the plans.

    a. If saw cuts are specified, provide a minimum of three (3) cuts performed at differing times during curing with no cut occurring more than 18 hrs. after pour.
4. Obtain approval of mockups from Owner's Representative before starting construction.
5. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
6. Demolish and remove approved mockups from the site when directed by Owner's Representative.
7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

G. Formwork Observation: Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Notify Owner’s Representative 48 hours minimum prior to placing concrete that formwork is in place and ready for observation. Do not proceed with concrete placement prior to obtaining Owner’s Representative’s approval that formwork meets the lines and grades intended on the Drawings. Concrete placed without the Owner’s Representative’s approval of formwork shall be removed and replaced when directed by the Owner’s Representative, at no additional cost to the Owner.

1.5 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities. Provide barricades, cones and signs required for driveway closures and detours. See Division 01 Section “Temporary Facilities and Controls” for additional requirements.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Provide appropriate form liner material to shape the reveal patterns indicated on the Drawings.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

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

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

C. Reinforcing and Tie Bars: ASTM A 615/A , Grade 60; deformed.

D. Steel Bar Mats: ASTM A 184; with ASTM A 615, Grade 60, deformed bars; assembled with clips.

E. Plain Steel Wire: ASTM A 82, as drawn.

F. Deformed-Steel Wire: ASTM A 496.

G. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

H. Joint Dowel Plates: Steel load plates, ASTM A36, ASTM A615 or A108-03 grade 1018, with high density ABS plastic pocket former.

1. Product: PNA, Inc. ‘Diamond Dowel,’ or equal.
2. Load plate size: 3/8-inch thick by 4 1/2 inches x 4 1/2 inches.

I. 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.

J. Slip Dowel Bar Sleeves: Proprietary plastic sleeve consisting of a polypropylene plastic sleeve and a reusable base. Greenstreak, ‘Speed Dowel,’ or equal.

2.3 CONCRETE MATERIALS

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

1. Portland Cement: ASTM C 150, Type I or II or I/II, gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C or F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

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

1. Maximum Coarse-Aggregate Size: Not exceeding 1 inch nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement, when tested in accordance with ASTM C 1260.

C. Water: ASTM C 94.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide 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.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

2.4 COLOR MATERIALS

A. Color Pigment: ASTM C 979, colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Available product: L.M. Scofield Company “Chromix Admixture.” Two Colors to be selected by Architect.

2.5 RELATED MATERIALS

A. Joint Filler Strips: Where isolation joints are indicated, provide ASTM D 3575, closed-cell polyethylene foam backing, with removable joint cap.

B. Joint Primer: ASTM C 920, Solvent based primer for preparing concrete surfaces for adhesion to sealant. Provide product recommended for use by joint sealant manufacturer.

C. Backer Rod: Non-gassing, reticulated closed-cell polyethylene rod designed for use with cold-applied joint sealants where joint depth exceeds manufacturer’s recommended depth for joint sealant. Comply with ASTM C 1330, Type C. Size as required for joint design.

D. Joint Sealant: ASTM C 920, Type M, Grade NS or SL, Class 25, multi-component, traffic grade, polyurethane sealant. MasterSeal SL2, Sikaflex-2C NS TG, or Pecora DynaTred. Color to be selected by Owner’s Representative.

E. Silica Sand: Spherical, round or subangular quartz sand, clear to light grey in color, No. 70 mesh, or equal.

F. Bonding Agent: ASTM C 1059, Type II, non-re-dispersible, acrylic emulsion or styrene butadiene.

G. Color Tinted Curing Compound: ASTM C 309, Type 1, Class B, waterborne, membrane-forming compound specifically manufactured for colored concrete:

1. For integrally colored concrete, curing compound shall be pigmented type approved by coloring admixture manufacturer.
2. Available Product: L.M. Scofield Company "Lithochrome Color Wax."

    a. Provide "Color Wax" to match color of integrally colored concrete selected by Architect.

H. Curing Compounds for Non-Colored Cement Concrete: Clear, ASTM C 309, Type 1, Class A, low gloss, non- staining.

I. ADA Detectable Warning Tile:

1. Vitrified polymer concrete cast-in-place detectable/tactile warning surface tiles shall be epoxy polymer composition with an ultra-violet stabilized coating employing aluminum oxide particles in the truncated domes. The tile shall incorporate an in-line pattern of truncate domes measuring nominal 0.2 inch height, 0.9 inch base diameter, and 0.45 inch top diameter, spaced center-to-center 2.35 inches as measure on a diagonal and 1.67 inches as measure side by side.
2. For wheelchair safety the field area shall consist of a non-slip surface with a minimum of forty 90 degree raised points 0.045 inch high per square inch.
3. Approved product: 'Armor-Tile' as manufactured by Engineered Plastic, Inc. Tel.: 800-682-2525, or approved equal.
4. Size: 24 inches by length shown on drawings.
5. Color: Federal yellow

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 4 to 4-1/2 inches without Water-Reducing Admixtures; 5 inches with Water-Reducing Admixtures.

    a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: When a high-range water-reducing admixture is used, the maximum limit may be increased an additional 2 inches.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 4 to 6 percent.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

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

1. Use water-reducing admixture and/or high-range, water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:

1. Fly Ash: 20 percent.
2. Ground Granulated Blast-Furnace Slag: 50 percent.
3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 20 percent.

2.7 CONCRETE MIXING

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

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

B. Project-Site Mixing: Comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete mixes of 1 cubic yard or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete mixes larger than 1 cubic yard, increase mixing time by 15 seconds for each additional 1 cubic yard.

C. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Examine existing grade conditions where proposed work will adjoin. Verify proposed gradients and elevations can be achieved and meet existing grade conditions on site. Any nonconforming conditions shall be brought to the attention of the Owner's Representative and corrected before proceeding with concrete placement operations.

3.2 PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

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

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Formwork: Design, construct, erect, shore, brace, and maintain formwork according to ACI 301, and to achieve the specified concrete thickness.

B. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement 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.

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

3.4 STEEL REINFORCEMENT

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form all joints and tool edgings 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 pavement and where pavement operations are stopped for more than 1/2-hour. Termination points shall occur at a scoring location indicated on the plans.

1. Install dowel plates at construction joints in concrete paving.
   a. Install pocket former and dowel plate per manufacturer's printed instructions.
   b. Use templates for locating pocket former at the correct position for specified concrete thickness.

2. Butt Joints: Use a bonding agent at butt joints where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints abutting building slabs, walls, catch basins, manholes, inlets, light pole bases, structures, other fixed objects and where indicated on the Drawings.
1. Joint Filler and Sealant Installation: Install joint filler strips and sealant as follows at isolation joints.
   a. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   b. Extend joint fillers full width and depth of joint.
      1) Terminate joint filler flush with top of paving for joint fillers having removable joint cap.
      2) Terminate joint filler 1/2 joint width below top of paving for joint fillers without removable joint cap.
   c. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
   d. Allow concrete to cure minimum of 28 days.
   e. Remove joint filler cap; clean and prime concrete surfaces to receive sealant per manufacturer's recommendations.
   f. If joint filler depth from top of paving exceeds 3/8 inch, install backer rod prior to installing joint sealant. Backer rod to be 25 percent wider than joint width. Sealant depth to be 1/2 width of joint, not to exceed 3/8 inch, whichever is smaller. Install backer rod and sealant per manufacturer's recommendations.
   g. Fill void with sealant to match concrete color unless indicated otherwise, and top with silica sand while still wet.
   h. Protect sealant from pedestrian and vehicular traffic until cured.
   i. Clean excess sealant from paved surfaces.

D. Doweled Isolation Joints: Install dowel plates, support assemblies and joint-filler strips where doweled isolation joints are indicated.
1. Locate doweled isolation joints at intervals as indicated on the Drawings.

2. Provide proprietary plastic pocket former per manufacturer's directions on one-half of dowel plate to prevent bonding of concrete.

E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated on the Drawings. Construct contraction joints for a depth of no less than 1/4 the overall concrete thickness. Locate at intervals of 12 feet maximum, unless otherwise indicated on the Drawings. Install contraction joints as follows:

1. Sawed Joints: Form contraction joints and score (decorative) 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 developing random contraction cracks. Extend saw cuts to the edge of concrete paving or face of adjacent vertical element.

F. Joints at Existing Paving: Install dowel bars and joint filler strips where new concrete paving meets existing concrete paving. Drill and epoxy one-half of bar into existing paving. Provide a slip dowel sleeve on the half of dowel embedded in new concrete to prevent bonding. Install dowel bars per manufacturer's directions and parallel to finish concrete surface.

G. Joints in Curbs and Gutters: Align joints in concrete curbs with joints in finish paving. Space contraction joints in curbs and gutters at maximum 10-foot intervals with isolation joints at a maximum of 50-foot intervals and at 90 degree corners unless indicated otherwise on the Drawings. Isolation joints shall be struck vertically and full depth.

H. Edging: Tool exposed edges of ramps, sidewalks, walkways and joints in concrete after initial floating with an edging tool to a 1/2 inch radius. Tool edges of concrete paving to a 1/4 inch radius where adjacent to other paving. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces leaving no "shiner" bands.

3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. No concrete shall be placed or finished in the rain. It shall be the Contractor's responsibility to schedule his operations such that concrete will not be placed or finished in the rain.

C. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

D. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

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

F. Do not add water to concrete during delivery, at Project site, or during placement.

G. Do not add water to fresh concrete after testing.

H. 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.

I. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

J. Place concrete pavement in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.

1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Owner’s Representative.

K. Screed pavement surfaces with a straightedge and strike off. 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.

L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved by Owner's Representative, remove and replace with formed concrete at no additional cost to the Owner.
1. Apply light broom finish to match adjacent concrete pavement

M. When adjoining concrete pavemens are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

N. Cold-Weather Placement: Comply with ACI 306R-10 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 degrees Fahrenheit, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees Fahrenheit and not more than 80 degrees Fahrenheit at point of placement.

2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

O. Hot-Weather Placement: Comply with ACI 305R-10 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 degrees Fahrenheit at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 CONCRETE FINISHING

A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the 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.

C. Concrete Finish: After final floating, apply a hand-trowel finish followed by a finish to concrete as follows:.

1. Walks, Stepped Walk, Curbs, Concrete Pads Below Furnishings
   a. Medium Textured Broom Finish: Draw a medium stiff bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, medium-line texture perpendicular to line of traffic to match approved mock up.
2. Splash Pad
   a. Exposed Aggregate Finish: Surface Retarded Exposed Aggregate Finish: After final floating, apply a hand-trowel finish followed by a surface retarded finish to concrete.

   b. Apply Chemical Surface Retarder uniformly over the surface of freshly placed concrete as soon as concrete finishing is completed and the bleed water has disappeared from the surface per manufacturer’s printed instructions.
   c. Test a section of the retarded surface prior to general aggregate exposure to determine if the underlying concrete has reached sufficient strength so that the aggregates will not be loosened or dislodged during removal procedures, and to match the Architect’s approved samples.

d. Remove the retarded surface by use of a long-handled, stiff-bristle brush and a pressure washer or a strong jet of water from a hose. Pressure washing will facilitate removal, especially in larger areas. Control runoff in accordance with local, state, and federal regulations.

e.

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 306R-10 for cold-weather protection; and ACI 305R-10 for hot-weather protection.

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

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

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.9 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 for driveways, roadways, ramps, sidewalks, walkways, plazas and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.

5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports. Contractor to provide samples as required for Owner testing.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 degrees Fahrenheit and below and when 80 degrees Fahrenheit and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39; test 1 specimen at 7 days and 2 specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Owner’s Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of

concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7-day and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner's Representative but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner's Representative.

G. Remove and replace concrete where test results indicate that it does not comply with specified requirements at no additional cost to the Owner.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements at no additional cost to the Owner.

3.11 ADA DETECTABLE WARNING TILE INSTALLATION

A. Follow manufacturer's printed instruction for installation of tiles. The factory-installed sheeting must remain in place during the entire installation process.

B. Place and finish the concrete true to line and grade prior to the tile placement. Place the tile true and square to the curb edge as indicated. Cut tiles equally to form radius when tiles are installed along a curve.

C. Individual tiles may be bolted together using 1/4-inch hardware to ensure that adjacent tiles are flush to each other during the installation process. Tape or caulk underside of bolted butt joint to prevent concrete from rising between adjacent tiles during installation.

D. When preparing to set the tile, do not remove freshly placed concrete in the area to accept the tile. Set the tile directly into freshly placed concrete.

E. Ensure that the tile is flush with adjacent concrete surfaces and true to line and grade indicated.

F. Provide a 3/8 inch radius edge around the perimeter concrete where it meets the tile.

G. After the concrete has cured, remove the protective plastic wrap completely from the tile.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete that is broken, damaged, or defective or that does not comply with requirements in this Section at no additional cost to the Owner.

B. Drill test cores, where directed by Owner's Representative, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory concrete areas with portland cement concrete bonded with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

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

3.13 CLEANING

A. Remove all excess material, debris, and equipment from site upon completion of work in this Section. Keep work area clean and in an orderly condition during the course of the Work.

B. Do not dispose of waste concrete or wash out materials on the site unless otherwise directed by the Owner's Representative. Areas to be paved may be acceptable for concrete truck wash areas only as approved by the Owner's Representative.

END OF SECTION 32 1313

SECTION 32 1400 - UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Concrete unit pavers set in mortar setting bed.

B. Related Sections include the following:

1. Division 2 Section “Earth Moving” for preparing subgrades and base course under unit pavers.
2. Division 3 Section “Cast-in-Place Concrete” for concrete bases under unit pavers
3. Division 32 Section “Concrete Paving” for cast-in-place concrete curbs and bands serving as edge restraints for unit pavers.
4. Division 32 Section “Concrete Paving” for expansion joints and sealants for mortar set unit pavers.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Concrete pavers.
2. Expansion joints, all components.
3. Masonry Cleaner

B. Samples for Verification:

1. Submit three product samples of full-size units of each type of unit paver indicated in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
2. Grout Samples for Initial Selection: Submit manufacturer’s color charts showing the full range of colors for selection by Architect.
3. Joint Sealant Samples for Initial Selection: Submit Manufacturer’s full range of colors for selection by Architect.
4. Grout Samples for Verification: Submit three 4 inch long product samples of the colored grout selected by Architect installed between unit pavers or as required to show the full range of colors to be expected in the finish work.
5. Joint Sealant Sample for Verification: Submit three 4 inch long product samples of the colored grout selected by Architect installed between unit pavers or as required to show the full range of colors to be expected in the finish work.
6. Expansion Joint Filler Material: Submit one 12 inch length.
7. Backer Rod Material: Submit one 12 inch length.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Compatibility and Adhesion Test Reports: From latex-additive manufacturer indicating the following:

1. Mortar and grout containing latex additives have been tested with pavers for compatibility and adhesion.
2. Interpretation of test results relative to mortar and grout performance and written recommendations for installation practices needed for adhesion.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed unit paver installations similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

C. Pre-construction Coordination: Review installation procedures and coordinate paving work with other work affected by the unit paving work. Prior to beginning construction, coordinate critical dimensions of pavers with flatwork, so that there is minimal paver cutting required. Field verify that layout shown on Drawings coincides with paver critical dimensions by constructing mockup as described below. Submit evidence to Owner’s Representative that this coordination work has been completed.

D. Mockups: Before installing unit pavers, build mockups for each form and pattern of unit pavers required to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work, including same base construction, edging, special features for expansion joints, and contiguous work as indicated:

1. Build mockups in the location as directed by Owner’s Representative and of approximately 4 by 4 foot size with all joint types in place including one expansion joint.
2. Build mockups in advance of concrete forms being laid out or constructed, so that the critical dimensions of the unit paving work may be coordinated with the surrounding flatwork.
3. Notify Owner’s Representative seven days in advance of dates and times when mockups will be constructed.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Owner’s Representative approval of mockups before starting unit paver installation.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mock-ups when directed.
8. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
9. For materials failing tests, obtain mortar and grout manufacturer's written instructions for corrective measures, including the use of alternative materials to obtain optimum bond and prevent staining.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect unit pavers and aggregate during storage and construction against soiling or contamination from earth and other materials.

1. Cover pavers with plastic or use other packaging materials that will prevent rust marks from steel strapping.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store liquids in tightly closed containers protected from freezing.

1.5 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout: Comply with the following requirements:

1. Cold-Weather Requirements: Protect unit paver work against freezing when atmospheric temperature is 40 degrees Fahrenheit and falling. Heat materials to provide mortar and grout temperatures between 40 and 120 degrees Fahrenheit. Provide the following protection for completed portions of work for 24 hours after installation when the mean daily air temperature is as indicated: below 40 degrees Fahrenheit, cover with weather-resistant membrane; below 25 degrees Fahrenheit, cover with insulating blankets; below 20 degrees Fahrenheit, provide enclosure and temporary heat to maintain temperature above 32 degrees Fahrenheit.
2. Hot-Weather Requirements: Protect unit paver work when temperature and humidity conditions produce excessive evaporation of setting beds and grout. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 degrees Fahrenheit and higher.

a. When ambient temperature exceeds 100 or 90 degrees Fahrenheit with a wind velocity greater than 8 mph, set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 CONCRETE PAVERS

A. Concrete Pavers:

1. Requirements: Solid, concrete paving units, ASTM C 936, made from normal-weight aggregates in sizes and shapes indicated. Average compressive strength of 8000 PSI with no individual less than 7300 PSI when tested to ASTM C140 standards.
2. Maximum Average Absorption: 5 percent, with no greater than 7 percent.
3. Freeze Thaw: ASTM C 67, no breakage and not greater than 1.0 percent loss in dry weight of any individual unit when subjected to 50 freeze thaw cycles.
4. Abrasion Resistance: ASTM C 418, maximum 15 cubic centimeters volume loss per 50 square centimeters with average thickness loss not exceeding 3mm.
5. The Contractor is hereby advised that some concrete pavers manufactured and delivered will not be acceptable for use in the Work for any exposed face, edge or corner treatment, and therefore, may require that some of the pavers be rejected for use on this Project.

    a. Permissible Extent of Chippage from Edges and Corners: 1/16 inch and 1/8 inch, respectively. The cumulative length of chips on the exposed face of a single unit shall not exceed 2 percent of the perimeter of the exposed face of the paver, and no single chip shall exceed 1/8 inch in length.
    b. Other than chips, the paver shall be free of cracks, color and other imperfections detracting from the appearance of a designated sample when viewed from a distance of 5 feet.

B. Concrete Paver Types:

1. Concrete Paver Type 1 (Mortar Set):

    a. Manufacturer: Keystone Hardscapes.
    Contact: Willamette Greystone. 1-503-669-7612.
    b. Product: CityStone
    c. Size: 6x12, 80mm
    d. Color: Charcoal

2.2 ACCESSORIES

A. Expansion Joint Material: Preformed: closed-cell polyethylene joint filler designed for use in cold joints, construction joints, or isolation joints wider than 1/4 inch. Comply with ASTM D 1056, Grade 2A1.

B. Backer Rod: non-gassing, reticulated closed-cell polyethylene rod designed for use with cold-applied joint sealants. Comply with ASTM C 1330. Size as required for joint design.

C. Joint Sealant: Two component, self-leveling, traffic rated, slope-grade elastomeric polyurethane sealant for horizontal joints. Plus or minus 25 percent movement capability

for horizontal joints; ASTM C 920, Type M, Grade P, Class 25;. Color to be selected by Architect from manufacturer's color palette.

D. Sealant Primer: ASTM C 920, Solvent based primer for preparing concrete surfaces for adhesion to sealant. Provide product recommended for use by joint sealant manufacturer

E. Joint Cleaner: Non-corrosive and non-staining type recommended by sealant manufacturer and compatible with joint forming materials.

F. Welded Wire Fabric Sheets: Hot-dip galvanized, welded, 12 gauge diameter wire; 2-by-2-inch mesh; comply with ASTM A 123, ASTM A 185 and ASTM A 82 except for minimum wire size.

G. Masonry Detergent for cleaning masonry after installation.

1. Detergent based solution designed for cleaning new masonry. NMD 80-New Masonry Detergent , by EACo Chemical Inc., New Castle, PA, Tele:800-313-8505. Or approved equal.

2.3 MORTAR SETTING-BED MATERIALS

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

B. Sand: ASTM C 144.

C. Latex Additive: Acrylic-resin or styrene-butadiene-rubber water emulsion serving as replacement for part or all of gauging water, of type specifically recommended by latex additive manufacturer for use with field-mixed portland mortar bed, and not containing a retarder. Weather, frost, shock resistant complying with ANSI A118.4 test and equal to Laticrete 3701 Mortar Admixture.

D. Water: Potable.

2.4 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement as required to produce required color.

1. Latex Additive: Manufacturer's standard acrylic-resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed sand-portland cement grout.

B. Grout Colors: As selected by Architect from manufacturer's full range.

2.5 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturer's written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times,

and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimum performance characteristics. Discard mortars when they have reached their initial set.

B. Mortar-Bed Bond Coat: Mix neat cement or cement and sand with water to a creamy consistency.

C. Portland Cement-Lime Setting-Bed Mortar (Thick-set): Weather, frost, shock resistant complying with ANSI A118.4 test and equal to Laticrete 226 Thick Bed Mortar Mix gauged with Laticrete 3701 Mortar Admixture.

1. Pigmented Grout: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

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

B. Verify that concrete base is sloped for drainage and is free of standing water, dust, oil, grease, paint, wax, curing compounds, primer, sealers, form release agents, or any deleterious substances and debris which may prevent or reduce bonding. Conduct moisture tests to verify that concrete surfaces are completely cured, free from hydrostatic pressure and having a moisture content of less than 5 percent.

C. Verify that grout materials can be cleaned from pavers, or provide coating to pavers to facilitate removal of grout materials.

3.2 PREPARATION

A. Remove substances, from concrete substrates, that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Clean concrete substrates to remove dirt, dust, debris, and loose particles. This may require mechanical grinding and scarifying of the surface.

C. Neutralize any trace of strong acid or alkali from the substrate prior to mortar application.

D. Remove substances, protrusions and fins from concrete acting as edge restraints that could impair tight joints.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, and voids, which exceed the tolerances listed under Part 2. Do not use unit pavers outside the approved color range or unit pavers with discolorations and other defects that might be visible or cause staining in finished work.

B. Pavers shall be clean and free of foreign materials prior to installation. Clean mortar-set pavers of laitance.

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

D. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Where cutting is required, use the largest size unit possible. Avoid the use of pieces smaller than 3 inches or joint spaces greater than 7/16 inch.

1. Block splitter may be not used. Hammer cutting is not acceptable.

E. Joint Pattern: As indicated on Drawings. Path widths to be composed of whole, uncut pavers unless otherwise indicated. Pavers are to be cut to fit at intersections and when abutting walls and thresholds Cut pavers equally to form a consistent radius on curves.

F. Tolerances: do not exceed 1/16 -inch unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.

G. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide joint filler and backer rod for sealant-filled joints where indicated. Install joint filler before setting pavers. Sealant materials and installation are specified in Division 2 Section "Concrete Paving."

3.4 MORTAR SETTING-BED APPLICATIONS

A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply cement-paste bond coat over surface of concrete subbase about 15 minutes before placing setting bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch thickness for bond coat.

C. Place reinforcing wire over concrete base, lapped at joints by at least one full mesh and supported so mesh becomes embedded in the middle of setting bed. Spread and screed setting bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated. Hold edges of mesh back from vertical surfaces approximately 1/2 inch. Cut fabric at expansion joints.

D. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Cut back, bevel edge, remove, and discard setting-bed material that has reached initial set before placing pavers.

E. Wet pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

F. Place pavers before initial set of cement occurs. Immediately before placing pavers on setting bed, apply uniform 1/16-inch-thick, slurry bond coat to bed and to back of each paver with a flat trowel.

G. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set and disturb pavers for purposes of realigning finished surfaces or adjusting joints.

H. Spaced Joint Widths: 3/8 inch joints, with variations not exceeding plus or minus 1/16 inch.

I. Grout joints as soon as possible after initial set of setting bed.

1. Store grout at 70 degrees Fahrenheit for a minimum of 24 hours prior to installation.
2. For concrete pavers with grouted joints, apply paver sealer to the top surface of pavers, avoiding any application of sealer into joints to be grouted. Allow sealer to dry completely before grouting joints.
3. Force grout into joints, taking care not to smear grout on adjoining surfaces.
4. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
5. Tool exposed joints slightly concave, or as directed by Owner's Representative, when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
6. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.

J. Cure grout by maintaining in a damp condition for seven days, unless otherwise recommended by grout or liquid-latex manufacturer.

3.5 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units (color, spacing and elevation) as intended at no additional cost to the Owner. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement at no additional cost to the Owner.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point up joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean per manufacturer's written instructions.

1. Lightly pre-wet or flash-cool the paver surface (do not soak). If plant material is nearby, protect and/or keep wet during chemical application.
2. Apply New Masonry Cleaner through an EC Jet (or a pump sprayer diluted to 4:1 ratio) to the entire surface to be cleaned. Ensure to overlap each stroke to achieve even coverage.
3. Allow product to sit for 5 to 7 minutes, being careful to not allow the product to dry on the pavement surface.
4. Repeat application to melt remaining soils/stains/residue/efflorescence and allow product to sit for 5 to 7 minutes. If there is no foaming, the paver surface is ready to be rinsed.
5. The longer it stays on the paver surface, the cleaner the result and the least amount of rinsing is required. Do not allow the product to dry on the pavement surface.
6. Begin rinsing from highest elevation to lowest. Use long even strokes, overlap each stroke. Low pressure rinse with a pressure washer is recommended but not necessary.
7. Repeat steps 2-6, if necessary, to achieve desired result.
8. Inspect Joint Sand and re-sweep as necessary to ensure joint sand completely fills the joints between pavers.

END OF SECTION 32 1400

SECTION 32 1446 – LAWN PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this section includes the construction and installation of the grass paving: Cellular, non-biodegradable plastic mats, designed to contain small areas of soil and enhance the ability of a lawn to support vehicular and pedestrian traffic.

B. Related sections include the following:

1. Division 31 Section “Earth Moving” for placement and compaction of base course aggregate.
2. Division 32 Section “Soil Preparation” for amended topsoil infill.
3. Division 32 Section “Lawn and Grasses” for planting of lawns.
4. Division 32 Section “Plants” for planting of plugs.
5. Division 32 Section “Planting Irrigation” for pipe sleeve material used under lawn paving units.

1.2 REFERENCES

A. The American Society of Testing and Materials (ASTM).

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

C. Army Corps of Engineers - Technical Report GL-86-19, Appendix A.

1.3 SUBMITTALS

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

B. Material Test Reports: For geocell material.

C. Shop Drawings: Manufacturer’s shop drawings showing section layout and direction of unit expansion.

D. Samples for verification: Lawn Paver mat, minimum 150mm by 300mm size.

E. Particle Size Analysis: Crushed stone supplier’s sieve size and percentage passing for engineered base used for geocell infill material.

PART 2 - PRODUCTS

2.1 GRASS-PAVING MATERIALS

A. Grass Paving: Cellular, non-biodegradable plastic matts, designed to contain small areas of soil and enhance the ability of a lawn to support vehicular and pedestrian traffic. Include manufacturer's recommended anchorage system for slope conditions.

1. Lightweight injection-molded plastic interlocking units, 20 inches by 40 inches by 2 inches high open grid allowing maximum grass root penetration and development. Gross vehicle loading of 80,000 lb with H-20 rating. Standard color black. 72 cells per unit with bottom open area per unit 41 percent.
2. Products: Subject to compliance with requirements, provide the following:

a. Presto Geosystems GeoBlock 5150 available from GeoCHEM, Inc., Renton ,WA. Contact: Richard E. Linton, Tele. 1- 425-738-1474, Email rich@geocheminc.com, or approved equal.

B. Sand: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

C. Soil for GeoBlock Paving Fill: Amended topsoil as specified in Division 32 Section “Soil Preparation.”

2.2 GEOTEXTILE

A. Non-woven, complying with AASHTO M 288. TenCate Geosynthetics Mirafi 180N or equal.

2.3 TEMPORARY STAKE ANCHORS

A. No. 4 steel rebar or 1x2 wood stakes, length as required to secure geocell material in expanded position.

2.4 AGGREGATE SUBBASE

A. The granular subbase course shall be crushed rock complying with Division 31 Section “Earth Moving.”

2.5 ENGINEERED BASE MATERIAL

A. Engineered Base Material: A mixture of 30 percent amended topsoil and 70 percent engineered base.

1. Topsoil: See Division 32 Section “Soil Preparation.”
2. Engineered Base: Naturally or artificially graded mixture of washed, natural or crushed gravel, crushed stone, and natural or crushed sand having 30 percent void

space when compacted, and an AASHTO No. 5 designation with the following particle size analysis:

Sieve Size	Percent Passing
1-inch square	100
3/4-inch square	--
U.S No. 4	30 to 70
U.S No. 8	--
U.S. No. 200	3 to15

PART 3 - EXECUTION

3.1 SITE PREPARATION

A. Clear and grub the subgrade of all roots and organic matter. Excavate subgrade elevation to allow for thickness of lawn paving system so finish grade meets the lines and levels shown on the Drawings. Compact the upper 12 inches of the subgrade to a minimum of 95 percent of maximum dry density as measured by ASTM D 698, (Modified Proctor Test for cohesive soils).

3.2 EXAMINATION

A. Verify that site conditions are as indicated on the Drawings. Examine subgrade conditions to ensure soil is structurally adequate to support base course materials and design loads. Do not start work until unsatisfactory conditions are corrected. Check for insufficient compaction, slumping areas, improper gradients, debris, and improper drainage.

3.3 IRRIGATION

A. Install irrigation system prior to placement of aggregate base and lawn paving installation as shown in the Drawings. Protect equipment and pipe during aggregate base and lawn paving installation.

B. Sleeve irrigation lines under cellular confinement system in accordance with Division 32 Section “Planting Irrigation.”

3.4 GEOTEXTILE INSTALLATION

A. Install geotextile layer prior to placement of the aggregate subbase as indicated on the Drawings. Secure in position according to manufacturer’s recommendations.

3.5 AGGREGATE SUBBASE PLACEMENT

A. Place aggregate subbase in lifts not exceeding 6 inches and compact to a minimum of 95 percent of maximum dry density as determined by ASTM D 1557, (Modified Proctor Test for granular soils). The thickness of aggregate base layers, after compaction, shall be as indicated on the Drawings.

3.6 ENGINEERED BASE PLACEMENT

A. Add and blend topsoil with the engineered base to create the specified infill material prior to placement. The topsoil volume shall be equal to, but not greater than the aggregate void percentage.

B. Place the specified infill material to the depth indicated.

C. Compact the engineered base to a density that will provide a minimum California Bearing Ratio of 7 percent minimum.

3.7 GEOBLOCK INSTALLATION

A. Install the GeoBlock units by placing units with cells facing up, and using pegs and holes provided to maintain proper spacing and interlock the units. Shape units to fit layout. Anchor units using, rebar stake, self-tapping screws or 16d Common nails with fender washer through the perimeter interlocking tabs, as required to secure units in place. Tops of cells shall be 1/8 to 1/4 inch below the surface of adjacent hard-surface pavements.

B. Orientation and Laying Pattern of Units:

1. For access lanes: stagger the units to produce the running bond pattern. Positioned the units such that the long direction of the unit is perpendicular to the primary direction of traffic.
2. For random traffic flow: stagger the units to produce the herringbone pattern reducing straight seams to one and a half block lengths. Develop the staggered pattern by using half units made by field cutting a full unit and placing the half units to create the staggered pattern.
3. Other laying patterns are not recommended.

C. Positioning of Units:

1. Place the first row of units against a stationary edge when available. If the units are placed between two perpendicular or near-perpendicular stationary edges (i.e., two parallel concrete curbs) allow for potential thermal expansion of the units by keeping the units away from the stationary edge. Slide the units together so that the interlocking tab joint is fully engaged.

D. Install amended topsoil in cells as they are laid in sections. Spread the amended topsoil to fill the cells. Used a stiff bristled broom for final "finishing" of the amended topsoil. Compact the amended topsoil by using water from hose, irrigation heads, or rainfall. Finish grade shall not be less than the top of cells and not more than 1/4 inch above top of cells.

3.8 INSTALLATION OF GRASS

A. Install grass as shown on the Drawings and in accordance with Division 32 Section “Lawn and Grasses.”

3.9 PROTECTION

A. Protect from any traffic, other than emergency vehicles, for a period of 4 to 6 weeks, or until the grass is mature to handle traffic, or until the root system has penetrated below the grass paver units.

3.10 CLEANING

A. Remove and replace segments of grass paver units where three or more adjacent cells are broken or damaged. Reinstall as specified, so no evidence of replacement is apparent.

B. Perform cleaning during the installation of work and upon completion of the work. Remove all excess materials, debris, and equipment from site. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

END OF SECTION 32 1446

SECTION 32 18 16.13 - PLAYGROUND PROTECTIVE SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Unitary synthetic seamless surface.

B. Related Sections include the following:

1. Division 11 Section "play field equipment and structures" for play equipment.
2. Division 31 Section "Earth Moving" for drainage course drainage/separation geotextiles and subbase courses.

1.2 DEFINITIONS

A. Critical Height: Standard measure of shock attenuation. According to CPSC No. 325, this means "the fall height below which a life-threatening head injury would not be expected to occur."

B. SBR: Styrene-butadiene rubber.

1.3 PERFORMANCE REQUIREMENTS

A. Impact Attenuation: According to ASTM F 1292.

B. Accessibility of Surface Systems: According to ASTM F 1951.

C. Minimum Characteristics for Organic Loose-Fill Surfaces: According to ASTM F 2075.

1.4 SUBMITTALS

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

B. Shop Drawings: Show the following:

1. Layout of play surface colors.

C. Samples for Initial Selection: For each type of playground surface system indicated.

1. Include similar Samples of playground surface system and accessories involving color selection.

D. Samples for Verification: For each type of playground surface system indicated.

1. Minimum 6-by-6-inch- square sample of unitary synthetic seamless surface.

E. Qualification Data: For Installer and testing agency.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Organic loose-fill surface.

G. Material Certificates: For each playground surface system product, signed by manufacturers.

H. Maintenance Data: For playground surface system to include in maintenance manuals.

I. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain playground surface system materials, including primers and binders, through one source from a single manufacturer.

1. Provide secondary materials including adhesives, primers, and repair materials of type and from source recommended by manufacturer of playground surface system materials.

C. Standards and Guidelines: Comply with CPSC No. 325, "Handbook for Public Playground Safety"; ASTM F 1292; and ASTM F 1487.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit playground surface system installation to be performed according to manufacturers' written instructions and warranty requirements.

1.7 COORDINATION

A. Coordinate installation of playground surface systems with installation of playground equipment specified in Division 11 Section "Play Field Equipment and Structures."

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of playground surface system that fail in materials or workmanship within specified warranty period.

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

    a. Reduction in impact attenuation.
    b. Deterioration of surface and other materials beyond normal weathering.

2. Warranty Period: Five years minimum from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Basis-of-Design Product: The design for each product is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 UNITARY SYNTHETIC SEAMLESS SURFACE

A. Seamless Surface: Dual-density, poured-in-place or bond-in-place system with wearing course over cushion course. Provide manufacturer's standard thickness for each layer as required for overall thickness indicated, tested for impact attenuation according to ASTM F 1292 and for accessibility according to ASTM F 1951.

1. Available Products:
    a. Surface America Incorporated; Playbound Poured-in-Place. Or approved equal.
    b. Color: TBD.

2. Wearing Course: EPDM rubber particles of PVC and polyurethane or, aliphatic thermoplastic polyurethane pebbles.
3. Cushion Course: Formulation of recycled SBR particles and polyurethane, site mixed and applied or factory-fabricated units.
4. Binder: Weather-resistant, UV-stabilized, flexible, non-hardening, 100 percent solids polyurethane complying with requirements of authorities having jurisdiction for nontoxic and low VOC content.
5. Critical Height: 3 feet.
6. Overall Thickness: Not less than 2-1/2 inches.
7. Primer/Adhesive: Manufacturer's standard primer and weather-resistant, moisture-cured polyurethane adhesive suitable for unit, substrate, and location indicated.
8. Wearing Course Color(s): As selected by Architect from manufacturer's full range.
9. Filler/Sealant: Manufacturer's standard clear silicone or polyurethane filler/sealant suitable for exterior use.

B. Leveling and Patching Material: Portland cement-based grout or epoxy- or polyurethane-based formulation suitable for exterior use and approved by playground surface system manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare substrates to receive surfacing products according to playground surface system manufacturer's written instructions. Verify that substrates are sound and without high spots, ridges, holes, and depressions.

B. Concrete Substrates: Provide sound surface free of laitance, efflorescence, curing compounds, and other contaminants incompatible with playground surface system.

1. Repair unsatisfactory surfaces and fill holes and depressions.
2. Mechanically scarify or otherwise prepare concrete substrates to achieve recommended degree of roughness.

3.2 INSTALLATION, GENERAL

A. General: Comply with playground surface system manufacturer's written installation instructions. Install playground surface system over area and in thickness indicated.

3.3 INSTALLATION OF SEAMLESS PLAYGROUND SURFACE SYSTEMS

A. Seamless Surface: Mix and apply components of playground surface system according to manufacturer's written instructions.

1. Substrate Primer: Apply over prepared substrate at manufacturer's standard spreading rate for type of substrate.
2. Cushion Course: Spread evenly over primed substrate to form a uniform layer applied at manufacturer's standard spreading rate in one continuous operation, with a minimum of cold joints.
3. Intercoat Primer: Over cured cushion course, apply primer at manufacturer's standard spreading rate.
4. Wearing Course: Spread over primed base course to form a uniform layer applied at manufacturer's standard spreading rate in one continuous operation and, except where color changes, with no cold joints. Finish surface to produce manufacturer's standard wearing-surface texture.
5. Edge Treatment: As indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing and inspecting of completed applications of playground surface system shall take place according to ASTM F 1292.

C. Remove and replace applications of playground surface system where test results indicate that it does not comply with requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with requirements.

3.5 PROTECTION

A. Seamless Systems: Prevent traffic over system for not less than 48 hours after installation.

END OF SECTION

SECTION 32 76 00 - CRITICAL AREAS RESTORATION, ENHANCEMENT AND HABITAT IMPROVEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies landscaping, maintenance, and temporary irrigation for critical area restoration, enhancement areas, and habitat improvements.

B. Restoration, enhancement, and/or habitat improvement areas are identified in the Drawings as:
Site Restoration Planting Plan LR1.00

1.02 REFERENCED STANDARDS

1. A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

Reference	**Title**
ANSI Z60.1	American Standard for Nursery Stock
AOSA	Association of Official Seed Analysts, Rules for Testing Seeds
BSWCD	Benton Soil and Water Conservation District Invasive Species CWMA list
OSWB	Oregon State Weed Board (OSWB)
ODA	Oregon Department of Agriculture Rules for Seed Regulations and Labeling
ODA	Oregon Department of Agriculture Noxious Weed Policy
ORS Chapter 569	ORS Chapter 569: Weed Control
ODA	Oregon Administrative Rule (OAR) 603 Division 56: Hay and Seed

1.03 **SUBMITTALS**

A. Procedures: Section 01 33 00.

B. Qualifications.

C. Restoration, Enhancement, and Habitat Construction Plan:

1. 1. Submit no later than 60 days after Notice to Proceed.

D. Critical Areas Watering Plan.

2.

3. E. Plant Material Documentation:

Submit no later than 90 days after Notice to Proceed to verify availability of plant materials at time of planting:
a. List suppliers' names, addresses, and phone numbers.
b. List respective growing and storage locations.
Count of plants supplied and installed by species.
Provide verification of plant procurement no later than 120 days prior to installation.

F. Herbicide: Product Labels and Safety Data Sheet.

G. Temporary Irrigation Plan.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. Installers:
      a. Shall be specialists possessing sufficient technical competence, skills, resources and ability to complete the work specified.
      b. Shall have experience installing native plants under supervision of a qualified supervisor.
   2. Landscaping supervisor:
      a. Shall have similar experience identifying and installing native plants on a minimum of eight projects in the last five years.
   3. Commercial Pesticide Applicator: Oregon Department of Agriculture (ODA) licensed, including aquatic endorsement.
   4. Irrigation System Designer: Minimum one year of experience and one similar project.
   5. Irrigation System Installer: Minimum of one year of experience and one similar project.

1.05 RESTORATION, ENHANCEMENT, AND HABITAT CONSTRUCTION PLAN

A. The work plan shall include procedures and schedule of activities for mobilization within critical areas, weed eradication, earthwork, site restoration, site preparation; planting operations; mulching; and placement of habitat improvement features. The plan shall be in accordance with Albany Waterfront Redevelopment Landscape Restoration Plan and shall include, at a minimum:

1. Erosion and Sedimentation Control: Section 31 25 00.
   a. Include description of surface and groundwater management methods and materials: Section 31 25 40.
   b. Include description of how native soils and native vegetation will be protected during clearing and grubbing and planting activities.
2. Decontamination procedures for equipment and personnel prior to entering wetlands, wetland buffers, streams, and stream buffers to prevent the spread of invasive vegetation, wildlife, disease, and toxins.
3. Weed eradication layout and methods:
   a. Integrated Pest Management Plan that describes anticipated manual, biological, and chemical weed control methods.
   b. Hand and/or mechanized weeding:
      1) Show areas where weed and grass eradication will occur by hand or mechanized means.
      2) Describe equipment use and method of hand or mechanized weeding.
      3) Describe how re-sprouted or new weeds and grasses will be eradicated.
   c. Herbicide application:
      1) Shall be in accordance with this Section
      2) Show areas where herbicide will be used for weed and grass eradication:
         a) Permission to apply herbicide must be acquired a minimum of 72 hours in advance of each application from the Project Representative..
      3) List target weed species, aquatically-safe herbicides, and description of methods for herbicide application for each target species.
      4) Describe how re-sprouted or new weeds and grasses will be eradicated.
4. Site preparation methods:
   a. Describe equipment use and methods of scarifying soils compacted and/or compressed from construction activities.

b. Describe methods to protect scarified soils from re-compaction or re-compression during plant installation.

Planting:

a. Shall be in accordance with this Section.

Clean up and demobilization methods.

1.06 **CRITICAL AREAS WATERING PLAN**

A. Watering Methods:

Describe watering source, tools, and methods to enable hand watering of Riparian Forest and Riparian Groundcover Planting Zones during plant establishment.

Describe watering strategies to ensure adequate moisture for plant survival of Riparian Forest and Riparian Groundcover Planting Zones during prolonged hot and dry periods where temperatures are 80 degrees or greater and there is an absence of rainfall for 2 weeks.

Provide water quantities and a schedule for summer watering with the ability to adjust timing based on current weather patterns and conditions.

PART 2 **PRODUCTS**

2.01 GENERAL

A. Purchased materials are to be the product of firms regularly engaged in the cultivation of a specified species or manufacture of a specified material.

B. For native plants, refer to the following documents, in order:

Botanical identification and nomenclature of plant materials shall be based on descriptions by Hitchcock and Cronquist in “Flora of the Pacific Northwest, Second Edition (2018).”

Benton Soil and Water Conservation District Native Plant Database.

Oregon Flora Online Database.

2.02 **RESTORATION, ENHANCEMENT, AND/OR HABITAT IMPROVEMENT MATERIALS**

A. Plants:

Size, genus, species, and quantity indicated and complying with recommendations and requirements of ANSI Z60.1.

Grown in the states of Washington or Oregon in nurseries west of the Cascade Mountain range.

Emergent Plugs:

a. Grown from seed harvested West of the Cascades.
b. Several leaf shoots present.
c. Vigorous root growth at least six inches in length.

Trees:

a. Single leader, straight trunk (unless otherwise indicated in plant list).
b. Well branched, free of branches up to 4 feet high (unless otherwise indicated in plant list).
c. Symmetrical growth.

Shrubs and Woody Ground Cover:

a. Grown from seed harvested West of the Cascades.
b. Roots well established, but if in Container, not rootbound, J-rooted, or damaged.
c. Numerous branches, vigorous branches.
d. Without damage to any branches, bark, stems, or roots.
e. Symmetrical growth.

Herbaceous Perennials:
a. Grown from seed harvested West of the Cascades.
b. Main stem vigorous.
c. Side stems numerous.
d. Symmetrical growth.

Plant substitutions will not be allowed without written approval of the Owner's Representative.

PART 3 **EXECUTION**

3.01 GENERAL

A. Comply with requirements of Cultural Resources Investigation: Section 01 18 00

B. Implement the requirements in the Tree Protection Plan per Section 32 94 00 prior to commencement of the Work of this Section.

C. Water:

See Section 32 95 00 for watering requirements for plant establishment in addition to requirements below.

1. Provide water as needed to complete the work until Substantial Completion.
2. Provide necessary hose, equipment, attachments, and accessories for the adequate watering of planted areas during planting operations and maintenance.
3. Provide minimum of 1 inch of water per two weeks to plants in planted areas from May 1 through September 15 of each year. Watering shall be adjusted according to rainfall.

3.02 HERBICIDE APPLICATION

A. Shall comply with this section.

B. Use only aquatically approved herbicide, approved by Project Representative, prior to application.

C. Shall be used to eradicate Benton County Oregon Noxious Weed Control Board Weed List Class A, B, and C weeds and non-native grasses and other weedy plants after other mechanical and biological methods have been utilized, and as pre-approved and directed by the Project Representative within

1. restoration and enhancement areas.

D. Scheduling:

2. Spraying shall not be allowed:
   a. When temperatures exceed 85º F or are under 50º F.
   b. When wind velocities exceed 10 miles per hour.
   c. When foliage is wet, when it is raining, or rain is imminent.
1. d. During legal holiday periods.
2. Allow five days after chemical application before the installation of any seeding, trees, or other

1. plantings.

E. Application:

Qualified ODA-licensed Commercial Pesticide Applicator only.
Apply according to manufacturer's recommendations.

F. Equipment:

Shall consist of a back-pack sprayer,

Shall consist of injection system for knotweeds.
Shall consist of back-pack sprayer, handheld sprayer, or paint brush for cut stump treatments.

G. Protection:

Exercise extreme caution to prevent damage to native vegetation adjacent to invasive and weedy vegetation clearing areas.
Spraying shall occur at the minimum height possible and still maintain effectiveness of the herbicide.
Spraying shall occur pursuant to the manufacturer's recommendations labeled on the herbicide container.
The accepted herbicide used must have the manufacturer's label on the container at all times it is on-site and/or being used.
Mark areas where herbicide is applied.
a. Use blue dye spray indicator in water and herbicide mixtures during application.
b. Post markers at the time of application.
c. Place markers at points of entry to the area.
1) Markers must be a minimum of 4 inches by 5 inches and contain the words: "THIS LANDSCAPE HAS BEEN TREATED BY" as the headline and "FOR MORE INFORMATION PLEASE CALL" as the footer.
2) The company name and service mark with the applicator's telephone number where information can be obtained shall be included between the headline and the footer on the marker.
3) The letters and service marks shall be printed in colors contrasting to the background colors in the areas.
4) Markers must be weather resistant.
d. Remove markers no less than three days and no more than six days after each herbicide application.

3.03 SITE PREPARATION PRIOR TO PLANTING

A. Enhancement Areas:

Mark enhancement areas in the field and implement TESC measures prior to starting Site Preparation.
Remove all non-native vegetation by grubbing out all roots and stems up to a maximum depth of 6 inches.
For areas where soil underlying existing soil has deleterious materials such as concrete rubble, asphalt rubble, wood waste, metal waste products, plastic waste products, landscape refuse, and/or garbage:
a. Remove the fill material, rubble, waste, refuse and/or garbage from the top twelve inches of the existing soil and dispose of said material in a legal landfill.
Maintain areas free of weeds.
If soil amendments are necessary, apply soil amendments prior to planting.
Create a relatively smooth planting surface.
Install erosion control blanket no later than two weeks after clearing and grubbing activities to protect soil and minimize on site erosion.

3.04 **PLANTING AND SEEDING**

A. Plants:

Provide the quantity and sizes of trees, shrubs, and herbaceous species required to cover the habitat enhancement as indicated in the Drawings.

Quantities based on triangular spacing where the on-center spacing indicated in the Drawings is one side of a triangle.
Provide plant quantities as required to obtain full coverage of habitat enhancement.
Plants shall be in vigorous health and free of pests, disease, fungus, disfiguring knots, sun scalds, abrasions of bark, broken tops or limbs, torn roots, and other damage.
Plants cut back or pruned from large sizes to meet specified size will not be accepted.
Plants shall not have cuts over 1/4-inch in diameter that have not healed over.

B. Tagging:
Legible tag.
Tag by species each tree.
Tag by species with a minimum of one tag per 50 shrubs of the same species.
Emergent herbaceous plugs shall have a minimum one tag per 100 plants of the same species.

C. Planting Timing:
Shall occur between October 1 and March 15, as plant material is available from nurseries.
If planting is restricted due to high water levels, planting shall occur at the soonest opportunity presented by site conditions.
Planting outside of specified dates will not be allowed without written approval of the Owner's Representative.

D. Planting Operations:
Deliver plants following requirements of the supplier.
Indicate schedule for plant delivery a minimum of three weeks prior to arrival of material on the site.
Obtain Owner's Representative inspection of plant material prior to planting.
Remove rejected plants from the Site immediately and replace with specified plant materials.
Install plants as indicated in the Drawings.
Owner's Representative to be present during initial planting.

E. Pruning:
When delivered, no pruning shall be necessary for newly installed trees and shrubs.
However, if pruning becomes necessary to improve plant health, prune as requested by the Owner's Representative.
Trimming or cutting shall be performed by a certified arborist.

F. Emergent Herbaceous Plugs:
Install plugs only after soil has been decompacted and prepared.
Install plugs according to plans.
Tamp soil around plugs with boots to ensure they are anchored in soil or use biodegradable stakes to anchor plugs.

G. Planting Trees, Shrubs, Ground Cover, and Herbaceous Perennials:
Transport plant materials to their final location with care.
Plant material shall not be removed from the containers until immediately before they are planted.
Root systems shall be kept covered and damp at all times.
Install plantings only after the area has been prepared.
Under no circumstances will planting be permitted during unsuitable soil or weather conditions as determined by the Owner's Representative. Unsuitable conditions include frozen soil, high winds, heavy rains, and high water levels.

H. Planting Pits:

Excavate pit for trees and shrubs so that the vertical sides are twice the width of the root ball. Pit excavation on steep slopes shall be just wide enough to install plants and minimize soil destabilization.

Scarify the pit sides to allow for root expansion and tamp bottom mound to prevent plants from settling.

Set plant material in the pit to proper grade and alignment. Plants shall be upright and plumb and the top of the surface of the soil in the container or the bottom of the root flare must be flush with the finished grade or soil surface.

Backfill pit and tamp into place with foot.

In their final position, plants shall have their top true root (not adventitious root) no more than 1-inch below the soil surface, no matter where that root was located in the original root ball or container.

Backfill material and root ball shall be thoroughly watered on the same day that planting occurs regardless of season.

Do not stake trees and shrubs unless the plant cannot remain straight and upright without staking.

I. Inspection:

Following the installation completion of at least one area in each planting zone, notify the Owner's Representative. The Owner's Representative or designee will make an inspection of the planting work within two business days of notification and will notify the Contractor in writing of any corrective action necessary.

Correct unsatisfactory conditions and request re-inspection.

3.05 MAINTENANCE AND PLANT REPLACEMENT

A. Until Substantial Completion, maintain the enhancement areas:

Free of weeds:

a. Do not leave weed plant residues in landscaped areas.
b. Dispose of weed plant residues in a legal composting facility or waste facility.
c. Do not allow weeds to form seeds before removing them.
d. At no time shall weed plant areal leaf coverage exceed 10% of the total planted area.

In a clean, neat, and orderly manner at all times.

In a manner to promote plant health.

Water plants regularly as described in this Section.

Replace plants that do not meet the requirements for new plants as described in this Section within 1 month of notification of need for replacement either in Spring, March through May, or Fall, September through October.

END OF SECTION

SECTION 32 8400 – PLANTING IRRIGATION

PART 1 - GENERAL

1.1 WORK INCLUDES

A. This Section includes piping, valves, sprinklers, specialties, controls, and wiring for automatic-control irrigation system.

B. Related sections:

1. Division 31 Section “Earth Moving” for utility trench excavation, backfilling, compacting, and grading requirements.
2. Division 32 Section “Plants” for tree and shrub planting.
3. Division 32 Section “Lawn and Grasses” for seeding of lawns and grasses.
4. Division 26 Section “Common Work Results for Electrical” for providing electrical connection to irrigation controller(s).

1.2 DEFINITIONS

A. Mainline: Piping downstream from irrigation point of connection to valves. Piping is under constant pressure.

B. Lateral Line: Piping downstream from control valves to sprinklers, outlets, and drain valves. Piping is not under constant pressure.

C. The following are industry abbreviations for plastic materials:

1. PE: Polyethylene plastic.
2. PP: Polypropylene plastic.
3. PVC: Polyvinyl chloride plastic.
4. TFE: Tetrafluoroethylene plastic.

1.3 SUBMITTALS

A. Materials List: Within 30 days after award of Contract, and before any irrigation system materials are delivered to the job site, submit to the Owner’s Representative a complete list of all irrigation system materials proposed to be furnished and installed. Submit catalog data, including manufacturer's name and catalog number, model number, specifications, brochures, or other data giving complete information about each item.

B. Shop Drawings: Provide shop drawing of irrigation controller panel(s) showing all equipment to be supplied as part of pre-assembled irrigation controller assembly. Provide one shop drawing for each unique controller panel configuration.

C. Record Drawings: Provide Record Drawings illustrating actual as-built locations for all irrigation equipment per Division 01 Section "Closeout Submittals."

1. During the course of installation, carefully show in red line on a print of the irrigation system Drawings, all changes made to the irrigation system during installation. This drawing to be labeled "Record Copy". Make available for inspection. Do not use for construction.
2. Note lateral sizing on "Record Copy" as the system is installed. Use lateral sizing chart shown on the Drawings to size lateral lines.
3. Upon completion of the work, transfer all changes to a complete set of the construction drawings. Changes to work drawn to be cleanly erased and new work professionally drafted in proper locations. Dimension and note clearly all underground work located horizontally and vertically. Clearly mark each sheet with the words "As-Built" and date.
4. Submit As-Built Drawings for approval. If Drawings are not clear, or information is not complete, revise and resubmit for approval. Project will not be complete until As-Built Drawings are submitted and accepted by Owner's Representative.
5. Submit As-Built Digital Drawings after hard-copy drawings are approved. Digital drawings shall be in Auto CAD release 14 format or newer and copied onto a compact disk or zip disk. Submit at time of final examination for irrigation system.

D. Tools: Submit to the Owner two sets each, as appropriate, of controller keys, quick coupler operating keys with hose swivels, gate valve keys, air compressor valve keys, valve box keys, wrenches for removal and adjustment of type of sprinkler head, and unique tools or devices needed to access, operate, adjust or maintain the system. Submit at time of final examination for irrigation system.

E. Zone Map: Submit a laminated irrigation plan sized to fit inside each controller enclosure indicating by varying colors the area of coverage for each control valve. Showing which valves are activated by each station on the controller. Show the location and valve number of each valve and the corresponding controller station number. The valve numbers shall be the valve numbers shown on the As Built Drawings. The Zone Map may be made from a cropped copy of the As-Built Drawings. Submit to the Owner's Representative at time of final inspection for irrigation.

F. Guide Manuals: Submit operating and maintenance guides for the entire system and for each piece of equipment in the system. Instructions for system weatherization are to be included. Submit to the Owner's Representative at the time of the final examination of irrigation system.

G. Irrigation Schedule: Submit six 8-1/2 inches by 11 inches copies of an irrigation schedule. On the schedule, indicate the day(s) of the week each zone is watered, and the duration each zone is watered (in minutes).

1. Provide Irrigation schedule based on results of Irrigation Water Audit.

H. Testing Certificates:

1. Certification of backflow devices.
2. Hydrostatic pressure testing.

1.4 QUALITY ASSURANCE

A. Provide at least one person who shall be present at all times during execution of this portion of the Work, and who is thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation, and who shall direct all work performed under this Section.

B. Except where more stringent requirements are specified, conform to the "Uniform Plumbing Code" as adopted and modified by the State of Oregon and all legally constituted authorities having jurisdiction. If more restrictive than those specified herein, notify the Owner's Representative prior to starting work.

C. All materials and equipment in the system to be new and be brands and types as shown in the Drawings or as specified herein, or as accepted by the Owner's Representative.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Store materials in areas designated by the Owner.

C. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

D. Use all means necessary to protect irrigation system materials from damage, theft and vandalism before, during, and after installation.

E. In the event of damage, immediately make all repairs and replacements necessary to the satisfaction of the Owner's Representative, and at no additional cost to the Owner.

1.6 PROJECT CONDITIONS

A. Meet with Owner's Representative and Owner's maintenance staff on site to review scope of Work prior to installing any parts of the system.

B. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner's Representative no fewer than five days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without written permission of the Owner's Representative.

C. Locate and identify, with visible marking, existing underground utilities in the areas of work. Call for utility locations prior to digging – Dial 811. If utilities are to remain in place, provide adequate means of protection during excavation operations.

D. Should uncharted piping or other utilities be encountered during excavation, consult the utility owner immediately for directions. Cooperate with the owner and public and private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner. The cost of repairing charted utilities shall be paid by the Contractor at no additional cost to the Owner.

E. Protect buildings, equipment, utilities, sidewalks, paving, reference points, monuments, and markers on the site. Take extreme caution when trenching at adjacent to aggregate base courses, play area surfaces and around existing trees and their root systems. No root cutting is allowed without prior approval. Protect adjacent properties. Protect work by others. Replace or repair damaged items at no cost to the Owner and to the approval of the Owner's Representative.

F. Coordinate with other trades affecting or affected by Work of this Section.

1.7 WARRANTY

A. Warranty work and materials in writing for one year from the date of final acceptance, against defective workmanship and materials. All failures in workmanship or materials will be repaired at no additional cost to the Owner immediately after notification by the Owner's Representative.

B. Contractor shall be responsible for maintaining system and protecting it from all damage until date of Final Acceptance at no additional cost to Owner. This shall include damage caused by vandalism or adverse weather conditions.

1.8 ONE-YEAR CORRECTION PERIOD

A. Repair any settling of backfilled trenches occurring during the one-year correction period at no additional cost to Owner. Include complete restoration of all damaged planting, pavement, and or other improvements of any kind.

1.9 SYSTEM COVERAGE

A. The system is designed to provide full coverage, less plant interference, on all planting areas. It is anticipated that Contractor will exercise professional judgment in location, height, slope of sprinkler heads without measurably changing the system design. No changes shall be made in the system design without the prior approval of Owner's Representative.
   1. Refer to Section 3.18 of this specification for additional procedures and requirements specific to irrigation coverage testing.

1.10 SYSTEM FAMILIARIZATION

A. Upon acceptance of the system by Owner's Representative, Contractor shall provide the necessary keys and other tools necessary to operate, drain, and activate the system. Contractor shall train Owner's maintenance personnel and provide written instructions to ensure that the system operation, maintenance, and winterizing can continue after departure of the Contractor. Contractor will be liable for all damages or losses resulting from failure to comply with the provisions of this Article.

PART 2 - PRODUCTS

2.1 PIPES, TUBES AND FITTINGS

A. Steel Pipe: ASTM A-53, Schedule 40, Type S or E, Grade A or B, galvanized with threaded ends.

1. Steel Pipe Nipples: ASTM A-733, made of ASTM A-53 or ASTM A-106, Schedule 40, galvanized, seamless steel pipe with threaded ends.
2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
3. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron Flanged Fittings: ASME B16.1, Class 125, galvanized.

B. Ductile-Iron Pipe with Mechanical Joints: AWWA C151, with mechanical-joint bell and spigot ends.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

    a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Ductile-Iron Pipe with Push-on Joint: AWWA C151, with push-on-joint bell and spigot ends.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

    a. Leemco Deep Bell, ductile iron fittings and reducers for mainline pipe 3 inches and larger. Ductile iron grade 65-45-12, ASTM A-536
    b. Gaskets: AWWA C111, rubber.

2. Mechanical Joint restraints for ductile iron fittings: Clamps and tie rods, ductile iron ASTM A-536 with bolts and nuts, low alloy steel.

    a. Use mechanical joint restraints in lieu of concrete thrust blocks for 3 inch and larger mainline joints, as shown and scheduled on the Drawings. 'Leemco' Series LB, LG, LH and LMJ as recommended by the manufacturer, or equal.

D. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

E. Brass Pipe: ASTM B584 Alloy C84400 Standard Specifications for copper alloy sand casting for general applications.;

1. Brass Pipe Nipples: ASTM B-43, seamless red brass pipe with threaded ends.
2. Brass Pipe Fittings: ANSI B-16.15 cast copper alloy threaded fittings.
3. Brass Unions: ANSI B-16.15, Federal Specification WW-U-516 for Type III, Class A and Class B cast copper alloy threaded unions.

F. PVC Pipe, General:

1. Material used in the manufacture of the pipe shall be domestically produced rigid PVC 1120 compound, Type I Grade I, with Cell Classification of 12454 as defined in ASTM D-1784.
2. Pipe shall continuously bear the National Sanitation Foundation seal of approval for potable water usage and comply with the following requirements for product marking ASTM D-2241, D-1785 and D-2665 as applicable. Markings shall include: manufacturers name; nominal pipe size; outside diameter system; material designation code; applicable Standard thermoplastic pipe Dimension Ratio designation code (SDR number) or pipe schedule, and corresponding pressure rating in psi for water at 73 degrees Fahrenheit.
3. Belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D-2672.
4. Pipe sizes 1/2 inch and 1-1/4 inch are not allowed.

A. PVC Mainline: Mainline pipe 3 inches and larger shall be polyvinyl chloride, Class 200, SR-21, Ring-Tite PVC, bell-end gasketed pipe, conforming to ASTM D 2241 and ASTM D-1785 cell classification 12454-B; Gaskets shall conform to ASTM F 477.

1. Mainline pipe less than 3 inches in diameter shall be solvent welded Schedule 40 PVC ASTM D 2241 and ASTM D-1785 cell classification 12454-A,B.

A. PVC Lateral Line: ASTM D-1785, Schedule 40 for lateral pipe sizes 2 inches and smaller; and Pressure-Rated Pipe: ASTM D-2241, SDR 13.5, 315 psi minimum Class 315 for lateral pipe sizes 2-1/2 inches and larger.

B. PVC Nipples and Fittings:

1. PVC Socket Fittings, Schedule 40: ASTM D-2466; and Schedule 80: ASTM D 2467, NSF approved.
2. PVC Pipe Nipples: ASTM D-1785, PVC 1120 compound, Schedule 80.
3. PVC Threaded Fittings, Schedule 80: ASTM D-2464.

4. Fittings for mainline gate valves, manual drain valves, air relief valve and quick couplers shall be threaded Schedule 80 PVC, ASTM D 2464, with Schedule 80 PVC nipples, ASTM D-1785, PVC 1120 compound.
5. All socket fittings for PVC Schedule 40 mainline pipe to be Schedule 80 PVC.
6. All socket fittings for PVC Schedule 40 lateral line pipe to be Schedule 40.

C. Sleeves: PVC pipe under all paving, sized to accommodate required sizes and numbers of pipes and wires, 6-inch minimum diameter, in no case less than twice the diameter of the pipe being sleeved.

1. Schedule 40 PVC, ASTM D-1785..

2.2 JOINING MATERIALS

A. Copper Pipe Solder:

1. Silver solder, 45 percent silver, 15 percent copper, 16 percent, zinc, 24 percent cadmium and solidus at 1125 degrees Fahrenheit, and liquids at 1145 degrees Fahrenheit; conforming to ASTM B206-52T and Federal Specification QQB 00655.

B. Pipe Lubricant for Gasketed PVC Pipe: As recommended by the ductile iron fitting manufacturer; 'Duck Butter' or equal.

C. Pipe Solvent Cement:

1. PVC Solvent Cement ASTM D-2564.
2. 'Weld-On' I.P.S. 705 for pipe sizes up to 2 inch diameter.
3. 'Weld-On' I.P.S. 711 cement with P70 primer for pipe sizes 2-1/2 inches and larger.

D. PVC Primer:

1. 'Weld-On' I.P.S. P-70, ASTM F-656.

E. PVC Cleaner:

1. 'Weld-On' I.P.S. C-65, SCAQMD 1168, Low V.O.C.

F. Pipe Joint Sealant: Tape or silicon-base liquid applied pipe joint sealant; 'Teflon' or equal.

G. Saddle Taps:

1. Tapping saddles for installing remote control valves, quick-couplers, and combination valve on 3-inch and larger pressure mainlines. Double stainless steel straps with painted steel saddle. Size as required for application. Romac or equal.
2. Bronze tapping saddle with stainless steel straps for insert type flow sensor. Size as required for tapping PVC mainline, 'Romac' 202BS series, or equal.

H. Field assembled Swing Joints:

1. Rotors: Schedule 40 PVC fittings and Schedule 80 PVC nipples as shown on the drawings. Size to match inlet size of rotor head. Use is acceptable for all flows.
2. Quick Couplers: Schedule 80 PVC fittings and Schedule 80 PVC nipples as shown on the drawings. Size to match inlet size of quick coupler.

I. Pre-fabricated Swing Joint Assemblies:

1. Class 315 PVC construction with leak-proof "O-ring" seals. Size to match inlet size of pop-up rotor head or quick coupler. Use for flows greater than 4 gpm. Length as required. Lasco triple swing joint or equal.
2. Flexible PE swing pipe flexible riser assembly: Minimum 18-inch length polyethylene piping with black Marlex spiral barb fittings. Use for flows under 4 gpm. RainBird swing assemblies or equal.

J. Flex Riser at Bubbler Assemblies: Nylon-reinforced rubber hose with integral male pipe threaded ends. Custom length 8-inch long by 0.5 inch diameter.

1. KBI FR-500-8; No known equal.

2.3 GENERAL-DUTY VALVES

A. Shut-off Valve (Point-of-Connection): Bronze Gate Valve; MSS SP-80, Type 2; Class 125; 200 psig CWP Rating ; ASTM B 62 bronze body material with integral seat and screw-in bonnet; threaded ends; nonrising bronze stem; solid wedge; bronze disc; asbestos free Packing; malleable iron or bronze handwheel.

1. Nibco Model T-113; Matco-Norco Model 513T; or equal.
2. Size same as pipe on which it is installed.

B. Mainline Isolation Valves (3 inches and larger): Cast-Iron Gate Valves AWWA C-515, resilient-wedge, nonrising-stem, ductile-iron body and bonnet, with stainless steel stem and bronze stem nut, and with restrained ends to mechanically attach to a fitting or PVC pipe.

1. Minimum Working Pressure: 250 PSI.
2. End Connections: Mechanical joint or Flanged (as required by condition).
3. Interior Coating: 14-16 mil fusion bonded epoxy complying with AWWA C550.
4. American Flow Control; Leemco; or equal.

C. Mainline Isolation Valves (2-1/2 inches and smaller): Full port ball valve with threaded ends, minimum 400 PSI CWP rating, forged brass and cast bronze bodies and end pieces RPTFE seats and seals, blow-out proof stem design, chrome-plated brass ball, with stainless steel handle, 'Apollo' 70 Series or equal. Size same as pipe on which it is installed.

1. Valves 2-inches and smaller shall be equipped with stainless steel tee handle and nut; and 2-1/2-inch valves shall be equipped with stainless steel lever and nut.
2.

D. Isolation Valve For Electric Control Valve Assembly: unionized brass, angle-pattern, globe valve with screw-in bonnet, integral seat, 200 PSI CWP rating, conforming to MSS SP-80, size to be same as remote control valve: 'Champion' 300RS Series or equal.

E. Drain Valves (Mainline Drain Valves): bronze, angle-pattern, globe valve with screw-in bonnet, integral seat, 200 PSI CWP rating, conforming to MSS SP-80: 'Nibco' T-311-Y or equal, 1 inch minimum.

2.4 SPECIALTY VALVES

A. Quick Coupling Valve: Two-piece brass body1-inch with locking yellow**]** rubber cover, corresponding key and swivel hose ell. Provide with stabilizing wing. RainBird 44-LRCBuckner QB44RC or equal.

B. Remote Control Valves: Sizes and type as scheduled on Drawings.

C. Master Valve: Normally-open brassvalve. Size and type as scheduled on Drawings.

D. Backflow Preventer Assembly with Y-Strainer: Per Civil Engineer's Drawings.

E. Pipe Supports for Master Valve and Backflow Preventer: Standon Pipe Support, size as required.

F. Combination Air Release and Air and Vacuum Release Valve: Size and type as scheduled on Drawings.

2.5 VALVE BOXES And VAULTS

A. Valve Boxes: HDPE plastic boxes. 'Carson Brooks,' 'Pentek,' 'RainBird' or equal, with tee-style locking top and 6-inch extensions to facilitate required depth of installation where applicable. Lids shall be black unless otherwise noted.

1. Electric valves shall be installed in jumbo boxes.
2.
3. Isolation valves shall be installed in standard boxes.
4. Quick couplers shall be installed in 10-inch round valve boxes.
5. Drain valves shall be installed in 5-1/4 inches round adjustable valve boxes.
6. Grounding rods shall be installed in 7-inch round valve boxes with black covers.
7. Flow meters shall be installed in standard valve boxes**.**
8. Combination Air Release and Air and Vacuum Release Valves shall be installed in jumbo boxes with black covers.
9. Pull boxes and splice boxes shall be standard boxes with black covers.

B. Composite Vaults: Fiber-reinforced composite polymer vault with locking top. Lids shall be natural concrete color unless otherwise noted. Vault shall be constructed in single unit without extensions to accommodate full depth of assembly. Provide 6 inches minimum clearance on all sides of equipment housed within or as required by state and local codes.

1. Available Manufacturer: 'Utility Vault Company', 'Synertech', 'Oldcastle Precast' or equal.
2. Combination Valve: Shall be installed in a 24-inch x 24-inch x 24-inch deep.
3. Water Hammer Arrestor: Shall be installed in a 24-inch x 24-inch x 24-inch deep.

C. Concrete Vaults: Precast concrete vault shall accommodate full depth of assembly with minimum clearances as determined by state and local codes. Available Manufacturers: 'Oldcastle Precast', 'Jenson Precast' or equal.

1. Vault for Wye-Strainer/Backflow Device/Master Valve Assembly (4-inch wye-strainer, 4-inch backflow device, and 4-inch master valve): Precast concrete vault consisting of a base and top with dimension L9' x W6' x D4-1/2'(special order depth). Base shall be equipped with knock-outs, sump and lift holes. Top to be precast concrete with spring-assisted galvanized diamond plate double doors with locking latch. Doors shall open fully (180-degrees). Top shall be equipped with 2-ton lift anchors. 'Utility Vault' Model No. 4686-LA (Top: Model No. 4686-T-42C and Base: Model No. 4686-B), or equal. Provide 3 cubic feet drain rock sump under vault.
2. Vault for Isolation Valve and Master Valves: (parallel master valves for high and low flow conditions with resilient wedge gate valve): Precast concrete vault consisting of a base and top with dimension L6' x W4' x D4'. Base shall be equipped with knock-outs, sump and lift holes. Top to be precast concrete with spring-assisted galvanized diamond plate single door with locking latch. Door shall open fully (180-degrees). Top shall be equipped with 2-ton lift anchors. 'Utility Vault' Model No. 644-LA (Top: Model No. 64-325P and Base: Model No. 644-B), or equal. Provide 3 cubic feet drain rock sump under vault.
3. Vault for Flow Meters Assembly (parallel 3-inch insert flow meter and 2-inch tee style flow meter): Precast concrete vault consisting of a base and top with dimension L4' x W4' x D4'. Base shall be equipped with knock-outs, sump and lift holes. Top to be precast concrete with spring-assisted galvanized diamond plate single door with locking latch. Door shall open fully (180-degrees). Top shall be equipped with 2-ton lift anchors. 'Utility Vault' Model No. 444-LA (Top: Model No. 44-332P and Base: Model No. 444-B), or equal. Provide 3 cubic feet drain rock sump under vault.

D. Valve Box and Vault Accessories

1. Stainless steel 'penta' bolts for bolt-down covers.
2. Drain Rock: 3/4 inch to l/4 inch clean and washed pea gravel, no fines.
3. Filter Fabric: Woven or non-woven geotextile for use in separating drain rock from subgrade in valve box and vault installations while providing adequate drainage.
4. Brick or Concrete Block Supports: (2)-4-inch by 8-inch by 4-inch bricks or (1) 8-inch by 8-inch by 4-inch concrete paver at each corner of valve box.
5. Pipe Supports for Master Valve and Backflow Preventer: Standon Pipe Support, size as required. Provide flanged pipe supports for valves with flanged ends.

2.6 SPRINKLERS

A. As scheduled on Drawings.

2.7 AUTOMATIC-CONTROL SYSTEM

A. Control System: The control system assembly consists of a completely pre-assembled control system that is tested for operation and is housed within a cabinet. The components are pre-wired in the cabinet, which is to be mounted on a vertical surface. The only connections required are primary power, dedicated phone line, proper grounding, valve station wiring**,** and flow sensing. All conduits and wire runs are to be provided and installed by the Contractor. Equip controllers for remote radio operation.

1. Controller Stations for Automatic Control Valves:

    a. Each station is variable from approximately 0 to 120 minutes. Include switch for manual or automatic operation of each station.
    b. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate 2 or more times daily.
    c. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
    d. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages
    e. Surge Protection: Metal-oxide-varistor type on each station and primary power.

2. Controller Transformer: 24-V secondary, with primary fuse.
3. Grounding Rods and Clamps: Per manufacturer's recommendations.
4. Ground testing and verification of electrical continuity of control wires shall be completed and reported after the installation.
5. Controller: As scheduled on the Drawings.
6. Controller Components: As scheduled on the Drawings.

B. Exterior Control Enclosures: NEMA Type 3R rated, UL listed, weather and vandal-resistant, louvered for ventilation, with 3-point locking system cover, removable backboard and two matching keys; include provision for grounding.

1. Material: 100 percent stainless-steel sheet metal.
2. Mounting: As indicated on the Drawings.
    a. Pedestal mount onto pre-cast concrete base as indicated.
    b. Wall mount onto building where indicated.
3.

C. Sensors:

1. Flow Sensors: As indicated on Drawings.
2. Rain and Freeze Sensors: Hunter WFRC Wireless Rain/Freeze-Clik, RainBird Wireless Rain/Freeze Sensor Combo, or equal.

D. Electrical Control Wire and Accessories:

1. Single-strand copper, UL approved for direct burial, AWG-UF type, sized per manufacturer's recommendations, No. 14 gauge minimum for pilot wires, and No. 12 gauge minimum for common wires. Provide colored PVC jackets as listed below:

    a. Use red jacket wire for control valves pilot wires.
    b. Use white jacket wire for common wires.
    c. Use orange jacket wire for master valve pilot wire.
    d. Use yellow jacket wire for spare wires.
    e. Use blue jacket wire for tracer wires.

2. Control Wire Connectors: 3M/ DBY and DBR connectors, or equal.
3. Communication cable (for flow sensor): Paige Electric cable Model No. PE-89.
4. Communication Cable Splice and Cap: Preformed Line Products “Super Serviseal” closure with Poly-Bee sealant. Model No. 8006039.
5. Electrical Conduit and Fittings: High-impact Schedule 40 PVC C-2000 compound, UL approved, gray color, size as required. Solvent-weld fittings.
6. Pull Rope for Empty Conduit: 1/4-inch diameter, 12-strand, 1,200 lb tensile strength braided polypropylene rope.

2.8 OTHER MATERIAL

A. Identification Markers:

1. Detectable Warning Tape: Minimum 3-inch wide, 5 mils thick inert plastic tape with continuous layer of aluminum foil encased in the plastic. Tape identification shall match the utility being marked on all mainline. ‘Terra Tape’ Detectable, or equal.
2. Valve Identification Tags: Polyurethane tag with integral attachment neck and reinforced attachment hole. Tag shall be hot stamped alphanumeric lettering 1-1/8 inches in height. Christy (T. Christy Enterprises), or equal.
3. Control Wire Numbering Labels: Self-adhesive alpha-numeric labels. 3M or equal.

B. Quick Coupler Stabilizing Wing: Polyester-coated ductile-iron, with stainless steel bolt; Leemco or equal.

C. Concrete for Thrust Blocking: All concrete for thrust blocks shall achieve minimum strength of 3000 psi at 28 days.

D. Drainage Backfill: Cleaned gravel or crushed stone, open graded from 1 inch to 1/2 inch minimum.

E. Bedding Sand: Clean, crushed or naturally occurring rive sand with no particle size larger than 1/4 inch, and no more than 6 percent passing the No. 200 sieve.

F. All other materials not specifically described but required for a complete and proper irrigation system installation shall be new, first quality of their respective kinds, and subject to approval.

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to all work of this section, carefully examine the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the referenced standards, and the manufacturer's recommendations.

C. In the event of discrepancy, immediately notify the Owner’s Representative. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved. Start of work denotes acceptance.

D. Install materials and equipment in strict accordance with manufacturer’s written specifications and recommendations and all applicable codes.

E. Provide protection at all times to keep rock, dirt, gravel, debris, and all other foreign materials from entering piping, valves, and other irrigation equipment.

3.2 LAYOUT

A. Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design.

B. Layout to follow as closely as practicable the design as shown on the Drawings. Stake out locations of all proposed equipment for acceptance by Owner’s Representative, prior to trenching.

C. Full and complete coverage without overthrow onto roadways, sidewalks or buildings is required unless otherwise shown on the Drawings or as accepted by Owner’s Representative.

D. Systems shall meet minimum pressure at last head in each zone as shown on drawings. Notify Owner’s Representative immediately if any modification of piping layout will be required to accomplish this. Do not proceed until layout has been verified in the field with the Owner’s Representative.

E. Follow pipe layout plan making modifications as necessary to avoid trenching through roots of existing trees or other obstructions. Take care in protecting all existing tree root zones.

F. All valve boxes shall be located in shrub or ground cover beds. Mainline shall be run 24 inches from the edge of paving, or in lawn areas 24 inches from the edge of the adjacent shrub or groundcover bed.

3.3 WATER SOURCE

A. Connect system as indicated on Drawings. Make arrangements with the Owner for water shut-off, if necessary.

3.4 TRENCHING

A. Refer to Division 31 Section "Earth Moving" for excavating and trenching.

B. Locate existing utilities. Trench along routes as indicated on Drawings.

C. Trenches to be straight and true or conform to adjacent curved edges, with bottom uniformly sloped at a minimum 1 percent.

D. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Mainline Piping: Minimum depth of 24 inches below finished grade, or not less than 18 inches below average local frost depth, whichever is deeper.
2. Lateral Line Piping: 18 inches.
3. Drain Piping: 18 inches.
4. Sleeves: 24 inches under paving; 36 inches under roads.

E. Keep trenches free of pipe-damaging rocks and debris.

F. Trench to be 12 inches wide minimum and wide enough to allow all pipes to lie side by side with 6-inch minimum separation between pipes.

G. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.

3.5 PIPE

A. Install ductile-iron piping according to AWWA C600.

B. Do not use solvent cement on threaded joints. Wrap joints with minimum three wraps of Teflon tape.

C. Ensure that the inside of the pipe remains absolutely clean. Pipe ends shall be protected and not left open. Remove all foreign matter and dirt from inside of pipe before lowering into trench.

D. Lay pipe in accordance with standard practices, on solid foundation, uniformly sloped, substantially supported at all locations. “Snake” pipe slightly from side to side in trench to allow for expansion and contraction. Keep pipe markings visible.

E. PVC pipe joints to be solvent welded except as indicated on the Drawings. Cut pipes square, deburr, wipe from surface all saw chips, dust, dirt, moisture and all foreign matter which may contaminate the cemented joint. Clean pipe with pipe cleaner to remove dirt,

oil and grease. Apply primer and solvent cement. Make joints in accordance with manufacturer's recommendations.

F. For 90-degree turns in mainline pipe, install two 45-degree fittings.

G. For non-standard angles and bends, install double fittings to avoid stressing the pipe or fittings.

H. Underground lines shall have a minimum horizontal and vertical clearance of 12 inches from other utility lines. For lines crossing at angles from 45 degrees to 90 degrees with each other, maintain 6-inch vertical clearance. No line shall be installed parallel to and directly over another line.

I. Provide 6 inches clearance between pipes. Do not stack pipe unless accepted by Owner’s Representative to avoid tree roots.

J. Do no solvent welding of pipe when raining or when temperature is below 40 degrees Fahrenheit.

K. No fittings are to be closer than 6 inches apart.

L. Obtain tight, inseparable joints. Allow 24-hour curing before testing.

M. Install concrete thrust blocks at all changes of direction for mainline pipe 2-1/2 inch or greater in diameter. Place a minimum of 1 cubic foot of fully mixed concrete against the pipe and firm undisturbed soil in accordance with the pipe manufacturer’s recommendations.

3.6 IRRIGATION SLEEVES

A. Install piping and wiring in sleeves under sidewalks, roadways, parking lots, and railroads.

1. Install piping sleeves by boring or jacking under existing paving if possible.

B. Install separate sleeves for irrigation lines and control wires under pavement prior to placing pavement materials wherever possible.

C. Extend sleeves beyond pavement edge a minimum of 12 inches. Install sleeves with minimum 24 inches depth of cover to the top of the pipe.

D. If length of required sleeve is greater than the length of the unit of pipe, solvent weld joints. Otherwise all sleeves shall be of one continuous length of pipe.

E. Tape ends of sleeve closed to keep soil out of the sleeve until irrigation lines and control wire are installed.

F. Permanently attach a single length of 14 gauge trace wire above the entire length of the sleeve.

G. Stake both ends of sleeves with a readily visible stake extending 12 inches above-grade and below-grade to the bottom of the sleeve. Mark the above-grade portion of the stake with the words “Irrig. Sleeve”. Remove stakes after sleeves are recorded on As-Built Drawings and after irrigation lines and control wires are installed and accepted by Owner’s Representative.

H. Drive an 18-inch rebar stake above sleeve end locations and wrap trace wire around stake.

3.7 CONTROL WIRING

A. Install per manufacturer’s instructions with minimum 24 inch expansion loop at each controller.

B. All wire splicing to be made waterproof by using U.L. approved wire connectors and sealant. Follow manufacturer's instructions for installation.

C. All wire splicing shall occur only at the valve or at the controller.

D. Provide 2 spare wires, yellow in color, making a circuit to all valves and to controller. Coil 36 inches length neatly in each box.

E. Lay wire in trenches adjacent to mainline or lateral lines for maximum protection. Place wires 18 inches below grade in electrical conduit where there are no pipes in the trench.

F. Control wires to each solenoid from controller shall have a colored jacket, and common neutral wires shall have a white jacket.

G. All valve wiring back to controller to be identified and labeled with self-adhesive labels manufactured for this purpose prior to installation of the controller and remote control valves.

H. Control wires sharing the same controller shall all be the same color.

I. Provide different color pilot wires for each controller installed on the Project. Colors may repeat if separated by sufficient distance as approved by the Owner’s Representative.

J. Where there is more than one controller, common wires shall be white with a colored stripe to match the pilot wire color with which it is circuited.

K. Bundle and tape wires together at 10-foot intervals.

L. Provide 24 inches expansion loops at least every 100 feet in runs of more than 100 feet in length, at changes in direction along the mainline, and at entrance and exits to all sleeves under paving. Provide 24-inch expansion coils at connection to control valves. Provide expansion loops in neat 1-inch diameter coils.

M. Master Valve Control Wires shall be orange and white dedicated common wire for the master valve only, and with a yellow wire as a spare.

N. Flow Sensor Cable: Install communication cable from flow sensor to the irrigation controller inside electrical conduit and as recommended by manufacturer. Provide a minimum of 36 inches of slack communication wiring in the flow sensor valve box and in the base of the controller pedestals and cabinets. Splices between flow sensor and controller pedestal are not allowed. Provide pull boxes at 200 foot intervals and at roadway crossings.

3.8 CONTROLLERS

A. Install per manufacturer's directions where shown on Drawings.

B. Provide conduits for all wiring entering cabinet and enclosure.

C. Follow manufacturer's instructions for wire hook-ups.

D. Verify organization of zones with the Owner's Representative. Otherwise, follow the zone numbering as shown on Drawings.

E. Provide electrical storm protection as specified by the manufacturer to protect each controller.

F. Mount wall-mounted controller enclosures to exterior walls using top and bottom 'Uni-strut' tubes to provide a 1-inch air gap between the enclosure and the wall surface. Provide appropriate mounting hardware as recommended by manufacturer.

3.9 VALVES

A. General:

1. Install valve boxes plumb to grade in a neat and uniform pattern per manufacturer's directions, and as shown on the Drawings.
2. Coordinate valve box locations to avoid conflicts with plant locations.
3. Install valve with 3 inch of clearance between top of valve and underside of valve box cover, and with 3 inches minimum clearance between the valve assembly and all sides of the box.
4. Valve boxes shall not rest directly on pipe.
5. Install 1 cubic foot of drain rock in the bottom of all valve boxes.
6. Provide 1-inch clearance between bottom of valve assembly and top of drain rock.
7. Provide brass shut-off globe valve with integral union on upstream side of remote control valve. Provide schedule 80 PVC threaded nipples on both sides of the each remote control valve and one schedule 80 PVC union downstream of the valve.
8. Provide schedule 80 PVC threaded nipples and fittings at quick coupler and ball valves.
9. Thoroughly flush supply lines before installing valves.

B. Master Valves:

1. Thoroughly flush the mainline prior to installation of master valves. Install per manufacturer's directions and as shown on the Drawings. Place in specified vault with adequate clearance for servicing.
2. Provide a dedicated common and pilot wires plus one spare wire from each master valve to the irrigation controller.
3. Provide pipe, companion flanges, flanged-end ductile iron pipe, ductile iron fittings and mechanical joint restraints as required to install master valve.
4. Provide ductile iron fittings, joint restraints, PVC mainline and PVC fittings as required to install 2-inch by-pass master valve.

C. Flow Meters:

1. Install on mainline at depth specified for mainline and as per manufacturer's printed instructions and as shown on the Drawings. Place in specified vault with adequate clearance for servicing.

D. Control Valves:

1. Install only one remote control valve per box.
2. Provide schedule 80 PVC threaded nipples and unions at on both sides of the each control valve.
3. Follow manufacturer's instructions and adjust pressure regulating module to achieve optimum operating pressure for each zone.

E. Drain Valves:

1. Install manual drain valves at low points along mainline to ensure complete gravity drainage of all mainlines. More drain valves may be required than are shown on approved Shop Drawings. Provide required number of drain valves at no additional cost to the Owner.
2. Install one drain valve in point of connection vault immediately downstream of backflow preventer.
3. Pipe drain valves into approved drainage structures. Install drain piping with minimum of 18 inches of cover to top of pipe.
4. Drain Pockets: Where no drainage structures exist, excavate [1] cubic yard of soil material at discharge to drain valves. Backfill with drainage backfill to 12 inches below grade. Wrap drainage backfill with drainage fabric and backfill remainder with amended topsoil.

F. Quick Coupling Valves:

1. Provide schedule 80 PVC threaded nipples and fittings at quick coupler and ball valves.
2. Install quick coupler valves at 100-feet on center along all mainline and one at the point-of-connection and at each trash enclosure.
3. Stabilize quick coupler nipple with one 24-inch number 4 rebar stake or quick coupler stabilizing wing. Attach stake to nipple with two 1/2-inch stainless steel worm drive hose clamps.

G. Isolation Valves: Install isolation valves along mainline at all points-of-connection and upstream of all road and drive aisle crossings. Install plumb to grade in a neat and uniform pattern as per manufacturer's directions, and as shown on Drawings.

H. Combination Air Release and Air and Vacuum Release Valves: Install at high points along the mainline as indicated in the Drawings. Install below grade in vault.

3.10 BACKFLOW PREVENTER

A. Install per state and local codes, and as detailed. Install pipe supports as recommended by the manufacturer. Provide di-electric unions to insulate dissimilar metals in backflow assembly.

3.11 FLUSHING

A. Flush lines with water for a minimum of 5 minutes each zone prior to installation of irrigation heads.

B. Cap risers immediately after flushing.

3.12 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Where there is more than one controller on the Project, install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

B. Install valve identification tags on each automatic control valve per manufacturer’s recommendations.

C. Install control wire numbering labels on each control wire to correspond with the valve station number at both ends of the control wires. Label spare and trace wires.

D. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tape over underground piping, during backfilling of trenches.

3.13 TRACE WIRE

A. Place one strand of trace wire for all mainlines, and leave end at point of connection location. Tape wire to top of mainline at no less than 36-inch intervals. All trace wire shall be spliced together with water-tight splice connectors.

B. Run a 12-inch loop of trace wire into each valve box for ease of detection.

3.14 PRESSURE TESTING

A. Notify the Owner’s Representative five days before pressure testing.

B. Backfill trenches sufficiently to ensure the stability of pipe, leaving joints exposed.

C. Mainline and lateral lines may be tested at different times to allow isolation of either

D. Supply certified pressure gauge and force pump during tests.

E. Mainline Testing:

1. Thoroughly flush piping before testing. Cap all fittings on mainline fill with water. Do not install remote control valves prior to mainline pressure testing.
2. Test mainlines to control valves at 100 psi for 1 hour. If pressure loss occurs, inspect the entire system, make water-tight, and retest until no pressure loss occurs for the testing period.
3. Pressure test must show no pressure loss for the specified period and be accepted by the Owner's Representative before backfill of trenches will be allowed.

3.15 BACKFILLING

A. Refer to Division 31 Section "Earth Moving" for backfilling.

B. Delay backfilling until piping is pressure tested and accepted.

C. Place clean sand or approved backfill 3 inches below and 6 inches above all pipe. Fill the rest of the trench with approved material, free of rocks and debris capable of damaging pipe. Compact to adjacent soil density in 6 inches lifts.

D. Stones larger than 1-inch diameter are not allowed in backfill material.

E. Place metallic locating tape in all mainline trenches in accordance with manufacturer's instructions.

F. Fill mainline with water at approximately 25 psi during backfilling operations.

3.16 IRRIGATION HEADS

A. Install irrigation heads after pressure test approval.

B. Install sprinkler heads of types, sizes, and coverage at locations shown on Drawings.

C. Minor changes in head location may be necessary to achieve head to head coverage at no additional cost to Owner. Notify Owner's Representative for approval prior to making any changes. Document all changes on Project Site As-built Drawings as they occur.

D. Provide freedom of movement at all swing and swivel joints.

E. Adjust and set for optimum performance as shown on Drawings.

F. Locate heads adjacent to planters, mowstrips, walks, pavement, and curbs with a 2-inch minimum and 3-inch maximum clearance between head and hard surface.

G. Locate no head closer than 6 inches from building foundation.

H. Install protective concrete sprinkler blocks on sprinkler heads adjacent to vehicular paving where heads are not protected by curbs as approved by the Owner's Representative.

3.17 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized RainBird service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing. Representative to verify that all controller-related components are properly assembled and ready for use.

B. Backflow Preventer Testing: All backflow preventers shall be tested and certified for proper operation prior to being placed in operation.

1. Original copies of the certification shall be submitted to the Owner.
2. Backflow preventers shall be labeled with plastic laminated field history tag showing date and tester information.

C. Irrigation Coverage Test:
1. The irrigation controller shall be installed and fully functional at the time of the irrigation coverage test.
2. Valves shall be operated from the controller during coverage testing; manual valve operation will not be acceptable.
3. The coverage test procedure will be conducted by the Owner’s Representative only if the entire irrigation system is completely automated to include permanent electrical power.
4. Prior to commencement of any planting, the coverage test shall be performed and all required corrections completed.
5. The test procedures assume the entire irrigation system is operational at the time of coverage testing. Should project sequencing require installation of the system be parceled into segments, the following shall apply:
    a. As new segments of the system become operational, prior to testing; the system shall be flushed and recharged to eliminate any debris which may have entered the system.
    b. The contractor shall bear all financial responsibility to reimburse the Owner for all costs incurred by the Owner’s Representative due to parceling of the system installation.
6. Prior to the coverage test, make all required adjustments to the irrigation systems. Test the system to assure that all areas are irrigated completely and uniformly. Change or adjust heads and nozzles as required to provide full coverage, matching precipitation rates and meeting final grades. Do not spray onto pavement or structures.
7. When the sprinkler irrigation system is completed, and prior to beginning plant installation, perform a coverage test in the presence of the Owner’s Representative to determine if the irrigation coverage for all planting areas is complete and adequate. Notify the Owner’s Representative 48 hours in advance for the irrigation coverage test.

8. Furnish all materials and perform all work required to correct any inadequacies, to the complete satisfaction of the Owner's Representative. This shall include any changes affecting coverage due to any deviation from plans.
9. Operating sequence for all control valves must match the sequence as shown on the Drawings.
10. Provide a minimum of two working individuals for the duration of each coverage test. Each individual provided by the contractor must have a two-way communication device for proper manipulation of the control valve sequencing of the irrigation system during the coverage test procedure. The lead individual must be a representative from the installing contractor's company. During the irrigation coverage test, bring keys to unlock cabinets and valve boxes. Open all controller cabinets, enclosures, valve boxes which are part of the irrigation system.
11. At the end of the coverage test for any specified area, a Field Observation Report shall be generated by the Owner's Representative. This report shall serve as an Item/Action notification which may require the contractor to make changes and repairs as noted therein.
12. One return site observation shall be provided by the Owner's Representative to determine whether the items listed in the first site observation report have been corrected. After making the corrections noted in the Field Observation Report, notify the Owner's Representative at least 48 hours in advance, and perform another coverage test in the presence of the Owner's Representative for approval.
13. If the items have not been fully corrected or repaired to the complete satisfaction of the Owner's Representative, and as noted in the first Field Observation Report, the contractor must reschedule another field observation and shall bear all financial responsibility to reimburse the Owner for all costs incurred by the Owner's Representative for the failed field observation performed.
14. Any item listed in the Field Observation Report requiring action that is not considered to be a part of the original contract, must immediately be brought to the attention of the Owner. This shall be the responsibility of the contractor and must be done in a manner as to enable the contractor to correct the item prior to the next field observation.
15. Upon completion of each phase of work, the entire system shall be tested and adjusted to meet site specifications.

D. Irrigation Water Audit: Engage a Certified Landscape Irrigation Auditor or equivalent, to conduct a landscape irrigation water audit in accordance with The Irrigation Association's Landscape Irrigation Auditors Manual, latest edition.

1. Water audit will include data collection, spread sheets, and calculations for each irrigation station or zone showing:

    a. Catch can results.
    b. Precipitation rate calculations.
    c. Percent efficiency.
    d. Soil type infiltrations rates.
    e. Plant type.
    f. Percent slope of planting beds and lawn areas.
    g. Solar aspect relative to building (i.e., north-facing, south-facing, east-facing, or west-facing.).
    h. Solar gain (i.e., full sun. part sun/part shade, full shade.)

i. Proximity to reflected light and heat from building and wall, (i.e., close, medium, far.)
j. Water requirements based on evapotranspiration rates by season and adjusted by micro-climates.

2. Provide seasonal irrigation schedules based water audit data collection and results.

3.18 STARTUP SERVICE

A. Verify that controllers and all associated components are installed and connected according to the Contract Documents and are functioning properly.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

C. Complete startup checks according to manufacturer's written instructions.

3.19 CLEANUP

A. Remove debris from project site upon completion or sooner, if directed.

3.20 FINAL INSPECTION

A. Thoroughly flush, clean, adjust, and balance the entire irrigation system for complete coverage and efficient operation. Set heads to avoid over-spray on walks. Set up control wires to operate in an organized clockwise pattern. Upon 5 days written notice, demonstrate the entire system to the Owner’s Representative, proving that all valves and controls are properly operating and that the installed system is workable, clean, and efficient.

B. Contractor to deliver to the Owner the items scheduled for submittal at the time of the final inspection for irrigation.

3.21 WARRANTY

A. Full and complete head to head irrigation coverage without overthrow onto roadways, sidewalks, or buildings is required.

B. The warranty period relating to all products, materials, and workmanship will begin on the date of final acceptance of the work and extend for the period of one year.

C. The Contractor must repair or replace all defective materials and workmanship during the warranty period. The conditions of the warranty applies to all replacement material and repair work from the date such materials are installed or repair work done.

3.22 ADDITIONAL REQUIREMENTS

A. Provide Owner's Maintenance Personnel with system familiarization and 8 hours minimum of instruction in maintenance and operation of each piece of equipment installed.

B. Repair settling trenches. Include complete restoration of plantings, mulch, grades, pavements or other improvements.

C. Fall Winterizing Visit: Return to the job site at the beginning of the first winter season to perform a general inspection of the system, test all valves, lines, sprinkler heads, vacuum breakers, repair all leaks and faulty work, check operation of the system, adjust spray patterns for full coverage, drain system, show maintenance staff location of all drain valves and blow out points and restore all areas where trenches have settled.

D. Spring Start-Up Visit: Return in spring after the first winter season for system check and if necessary, restore system for spring and summer operation. Explain system and operation methods to maintenance staff. Restore all areas where trenches have settled.

END OF SECTION 32 8400

SECTION 32 9113 - SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, material and equipment required for placement and amendment of topsoil for areas to be planted, and the establishment of finish grades as shown on the Drawings and as specified herein.

B. Coordinate work with installation of other site work including earthwork, irrigation, seeding, and planting.

C. Related sections include the following:

1. Division 01 Section “Temporary Tree and Plant Protection,” for protecting trees remaining on-site that are affected by site operations.
2. Division 31 Section “Earth Moving” for preparation of subgrades prior to placement of topsoil and planting soils specified in this section.
3. Division 32 Section “Lawn and Grasses” for the procedures and requisite timing for seeding of lawns following topsoil preparation.
4. Division 32 Section “Plants” for planting placement of amended topsoil backfill.
5. Division 32 Section “Critical Areas Restoration, Enhancement and Habitat Improvement” for planting in the restoration areas. This section excludes the restoration areas.

1.2 DEFINITIONS

A. Finish Grade: Elevation of finished surface of amended topsoil soil.

B. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil

C. Amended Topsoil: Native or imported topsoil or surface soil modified with soil amendments and fertilizers.

D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

E. Topsoil: See Part 2 – Products.

F. Soil Ripping: Loosening the soil by dragging a ripping shank or chisel thru the soil to the depths and spacing specified, and further defined in this specification.

G. Soil Tilling: Loosening the surface of the soil to the depths specified with a rotary tine tilling machine, roto tiller, (or spade tiller), and further defined in this specification.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Fertilizers, including application rates.
2. Soil Amendments.
3. Herbicides.

B. Samples for Verification: For the following:

1. 1/2 cubic foot compost.
2. 1/2 cubic foot of each imported topsoil. Furnish one sample from each site from which soil is to be furnished.
3. Retain soil and compost submittals on site in sealed, accessible container for comparison to delivered soils.

C. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following:

1. Manufacturer's certified analysis for standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

D. Qualification Data: For testing agencies.

E. Material Test Reports: Date of testing on all reports shall be a maximum of 90 days prior to the date of submittal for review.

1. Soil Fertility and Agricultural Suitability Analyses and Recommendations Reports for the following:

a. Existing on-site topsoil: From three typical locations as selected by Owner's Representative, minimum 30 days prior to beginning soil preparation work.
b. Imported topsoil: Minimum 30 days prior to beginning soil preparation work.
c. Amended topsoil: Provide soil analyses and results for soil samples taken from 3**]** typical locations as selected by Owner's Representative, minimum 7 days after soil preparation work has been completed and prior to installing plants.

2. Compost Analysis: Provide analysis for one representative sample of compost minimum 30 days prior to compost being delivered to Project Site.
3. Compost Maturity: Provide results of Compost Maturity Test when submitting Compost Analysis Report and sample.
4. Soil Compaction Test: Provide results of soil compaction tests minimum of 7 days prior to planting and seeding.

F. Delivery Slips: Provide delivery slips for each load of delivered material as proof of shipment of specified materials.

G. Soil Placement Map: Contractor shall provide a plan showing placed location of each load of delivered soil, referenced to delivery slips.

1.4 QUALITY ASSURANCE

A. Soil Fertility and Agricultural Suitability-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.

1. Acceptable Soil Testing Laboratories are:

a. A & L Western Agricultural Laboratories, (503) 968-9225.
b. Western Laboratories, Inc, (800) 658-3858.
c. Soil and Plant Laboratory, Inc., (503) 557-4959.

B. Soil Analyses: Furnish soil analyses by a qualified soil-testing laboratory stating:

1. Soil Composition: USDA particle size analysis indicating percentages of sand, silt and clay, and percent organic matter.
2. Macro and micro nutrient fertility tests as determined by pH, salinity, nitrate nitrogen, ammonium nitrogen, phosphate phosphorous potassium, calcium, magnesium, soluble copper, zinc, manganese, iron, saturation extract boron and sodium analyses.
3. Sodium Absorption Ratio (SAR).
4. A Cover Letter shall be provided summarizing existing soil conditions and the Laboratory's recommendations.
5. Recommendations by the soil testing lab for fertilizer and soil amendments in pounds per 1,000 square foot or tons per acre, as necessary to correct soil deficiencies.
6. Noxious Weed Germination Test: a minimum of one 36 inch square by 3 inch deep soil sample for each topsoil source considered for use on the project. Place soil in tray with adequate drainage layer beneath, keep soil moist (not saturated) for 7 days in a temperature controlled greenhouse environment, provide photos and written report summarizing germination results.

C. Compost Testing Laboratory Qualifications: An independent laboratory, with the experience and capability to conduct the testing indicated following U.S. Composting Council Seal of Testing Assurance (STA) procedures, or equivalent.

1. Acceptable STA Compost Testing Laboratories are:

a. A & L Western Agricultural Laboratories, (503) 968-9225.
b. Control Laboratories, (831) 724-5422.

D. Compost Analysis: Provide documentation from supplier that compost has reached a monitored temperature of 140 degrees Fahrenheit for at least one week. Engage an independent soil testing laboratory to test representative sample(s) of compost and furnish compost analysis report for the following parameters:

1. Percent organic matter, percent moisture, percent inerts (foreign matter), pH, soluble salts, and particle size.
2. Nutrient content, including: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg) and Sulfur (S).

3. Trace Metals, including: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), and Zinc (Zn).
4. Maturity Indicator. Provide bio-assay results. Provide Carbon-Nitrogen ratio.
5. Stability Indicator: Provide respiration test results.

E. Request inspection and allow observation by Owner's Representative of prepared soils before planting.

F. Soil Compaction Testing: Furnish soil compaction standard tests per ASTM 698. Request inspection and allow observation by Owner's Representative of prepared soils before planting.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver packaged materials in manufacturer's unopened containers fully identified by name, brand, type, weight and analysis.

B. Store and handle packaged materials to prevent damage and intrusion of foreign matter.

C. Store stockpiled topsoil in area designated by Owner's Representative. Provide erosion control measures for stockpiled topsoil on site to prevent contamination of the soil. Refer to Division 31 Section "Earth Moving" for control of dust and erosion.

1.6 SOIL AMENDMENT BID QUANTITIES

A. Bid quantities and types of soil amendments shall be based upon those listed in this Section. Types of amendments required and quantities shall be adjusted as necessary based upon actual results of soil fertility and agricultural suitability analyses and recommendations for on-site topsoils.

B. Amount per 6-inch lift of topsoil over 1000 square-feet of landscape area:

1. 25 lbs. Gypsum (Calcium sulfate)
2. 35 lbs. Calcium carbonate limestone 'Calpril'
3. 35 lbs. Dolomite limestone 'Dolpril'
4. 8 lbs. Treble superphosphate (0-45-0)
5. 3 lbs. Ammonium nitrate
6. 4 ozs. Zinc sulfate
7. 8 ozs. Manganese sulfate
8. 1 oz. Laundry Borax
9. 6 cu-yds Compost

1.7 SITE CONDITIONS

A. Topsoil placement and soil preparation shall not take place during periods where saturated soil or surface water is present in work areas.

B. Work shall not take place when temperature is less than 32 degrees Fahrenheit, or when frozen soil exists on site.

1.8 COORDINATION

A. Coordinate soil preparation with Division 31 Section “Earth Moving” such that topsoil, soil amendments and fertilizers are incorporated into ground fill areas in specified lifts and to specified depths below finish grade for planting and lawn areas. Topsoils shall be amended per recommendations of the Soils Testing Laboratory.

B. Coordinate soil preparation with timing and procedures for installation of related site work including irrigation, seeding, and planting.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Topsoil Definition: ASTM D 5268; natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles, conforming to USDA classification for Loam or Sandy Loam; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inches in any dimension; and free of weeds, roots, and other deleterious materials, with the following physical properties:

1. Organic Matter: 6 percent minimum to 10 percent maximum.
2. Sodium Adsorption Ratio (SAR): less than 6.0.
3. Saturation Extract concentration for Boron: less than 1.0
4. pH range of from 6.5 to 7.5 (Saturation Extract Conductivity: less than 4.0 dS/m @ 25 degrees Celsius as determined in a saturation extract.
5. Non-soil components: less than 1 percent by volume.
6. Heavy metal concentrations: below the USDA per year load limit.
7. Minimal weed seed.

    a. If regenerative noxious weeds (including, but not limited to, quack grass, nutsedge grass, and horsetail) are present in the soil, all resultant growth including roots shall be removed throughout one-year period after acceptance of work at no additional cost to Owner.

B. Topsoil Source: Reuse surface soil stockpiled on-site. 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. Ensure no contamination of the soils occurs during earthwork and grading, and that the soil remains friable and free of debris.

1. Import Topsoil: Supplement on-site topsoil with imported or manufactured topsoil from off-site sources when quantities are insufficient. Import topsoil is subject to approval and shall conform to USDA soil texture class “Loam” certification by Soil Testing Analysis, no more than 12 months prior to delivery to the site. 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.

a. Provide one of the following as Import Topsoil:
    1) Rexius, Blended Soil Mix, (503) 635 5865
    2) ProGro, Landscaped Blend #2, (800) 682 3501

2.2 INORGANIC SOIL AMENDMENTS

A. Dolomitic Lime: Natural, agricultural limestone (calcium and magnesium carbonate) containing a minimum of 20 percent calcium and 11 percent magnesium and as follows:

1. Screen Analysis: 100 percent passing through No.30 sieve; 70 percent passing through No. 100 sieve; and minimum 30 percent passing through No.325 sieve.
2. Provide lime in form of granulated, prilled, dolomitic limestone, 'DoloPril' by Pacific Calcium, Inc., (877) 571-3555, or equal.

B. Calcitic Lime: Natural, agricultural limestone (calcium carbonate) containing a minimum of 36 percent calcium and as follows:

1. Screen Analysis: minimum of 100 percent passing through No. 10 sieve and a minimum of 80 percent passing through No. 100 sieve.
2. Provide lime in form of granulated, prilled, limestone, 'CalPril' by Pacific Calcium, Inc., (877) 571-3555, or equal.

C. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

D. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

E. Aluminum Sulfate: Commercial grade, unadulterated.

F. Gypsum: Agricultural gypsum; minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Sand: Clean washed river sand, free of calcium, chlorides and other deleterious substances.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-decomposed, commercially manufactured, stable, and weed-free organic matter, no food waste shall be a part of the compost. pH range of 5.5 to 7.5; 100 percent passing through 1/2-inch sieve; soluble salt content of 2.5 to 7.5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and shall conform as follows:

1. Tested, at minimum, every six months for noxious weeds.

2. Organic matter source (feedstock): Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
3. Organic Matter Content: 50 to 70 percent of dry weight as determined by ash method.
4. Moisture Content: 40 to 55 percent by weight
5. Free of refuse (less than 1 percent by dry weight), plastics, contaminants or any material toxic to plant growth.
6. Processed to meet U.S. Composting Council's Seal of Testing Assurance (STA) Program, or equivalent.
7. Carbon to Nitrogen Ratio: 30 to 1 or lower.
8. Composted for a minimum of 120 days and reach a monitored temperature of 140 degrees Fahrenheit for at least one week.
9. Available Products and Suppliers:

    a. Rexius Forest By-Products, Inc., Garden Compost , phone (541) 342-1835.
    b. Fine Como-Stuff by McFarlane's Bark, phone (503) 659-4240 (www.mcfarlanesbark.com).
    c. Or approved equal.

2.4 FERTILIZER

A. Fertilizer composition and rate to be determined based upon soil analysis. For bidding purposes, assume: 10 Nitrogen (N), 10 Phosphorus (P), 10 Potassium (K), 5 Sulfur (S) applied at a rate of 10 pounds per 1000 square feet in all planting beds and seeded areas.

B. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and [10] [20 percent phosphoric acid.

C. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent of urea formaldehyde, phosphorous, and potassium in the following composition:

    1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

E. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium derived from natural organic and inorganic sources in the following composition:

    1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.5 MISCELLANEOUS PRODUCTS

A. Post-Emergent Herbicide: Select one of the following: “Glyphogan Plus” by Mana, “Envoy Plus” by Valent, “Crossbow” by Dow AgroSciences, “Landmaster BW” by Agri Star or approved equal.

B. Pre-Emergent Herbicide: “Ronstar-G” by Bayer, “Dimension EC,” by Dow AgroSciences or equal. Products containing either pendimethalin or DCPA are prohibited.

C. Contact Herbicide for controlling nutsedges: “SedgeHammer” by Gowan.

PART 3 - EXECUTION

3.1 EXAMINATION OF SITE CONDITIONS

A. Examine for site conditions that will adversely affect execution, permanence, quality of work, and survival of plant material and grasses.

B. Identify areas to receive planting and lawn on site.

C. Verify that subgrades and slopes of lawn and planting areas are acceptable to Owner’s Representative prior to commencing work of this Section.

D. Should the Contractor find any discrepancies between the Drawings and the physical conditions, inform the Owner’s Representative immediately for clarification.

E. Begin Work required under this Section only after conditions are satisfactory.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and existing lawns and exterior plants from damage caused by soil preparation operations.

B. Prepare soils at a time when moisture conditions will permit proper cultivation.

C. Remove stones over 1-inch diameter, sticks, roots, mortar, concrete, rubbish, debris, and all materials harmful to plant life, and legally dispose of them off Owner’s property.

D. Remove or spray as required to eradicate noxious weed growth and roots.

1. Achieve complete removal or kill of all weeds within all areas receiving new plantings and lawn areas.
2. In planting beds, kill achieved by working soil is permissible for annual non-noxious broad-leaf type weeds.
3. Apply post-emergent herbicide over all areas of weed or grass growth within landscaped area to eradicate weed growth and roots. Apply in two applications at manufacturer’s maximum recommended rate, as follows:

    a. First application: Apply 7 days prior to performing soil preparation.

b. Second application (to kill new vegetation): Apply after soil preparation has been completed and minimum of 48 hours prior to planting.
c. Observe manufacturer's recommended period prior to working in treated areas.

4. Apply contact herbicide directly onto foliage of nutsedges. In areas of established lawn grasses infested with nutsedge, apply herbicide by wicking. Do not spray.

E. Locate and securely mark or flag irrigation sprinkler heads, area drains, catch basins, clean outs, manholes, valve boxes, and other site improvements not extending above finish grade.

F. 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, in accordance with Division 31

3.3 SOIL PREPARATION FOR PLANTING AREAS

A. This article pertains to those shrub bed areas indicated as "Shrub and Groundcover Planting Areas" on the Drawings where mass plantings of trees, shrubs and ground cover plants are scheduled.

B. Excavate 24 inch deep by 12 inch wide pits for percolation testing where planting areas occur in soils compacted due to construction traffic, materials staging, stockpiles exceeding 72 inch height and areas of soil surcharging. Prepare a minimum of ten (10) test pits in locations selected by the Owner's Representative representing the full range of planting areas on site.
1. Fill holes to the top with water and let stand for 1 hour minimum.
2. Refill hole to top with water and measure total depth.
3. Allow hole to drain for 2 to 3 hours and measure total depth of water.
4. If soil drains at a rate of less than 2 inches per hour prepare subgrades in accordance with procedures for poor draining soils.

C. Planting area subgrade preparation:
1. Prepare subgrades by excavating and removing soil, rock and other construction material to 15 inches below finish grade. Cross-rip subgrades to depth of 6 inches prior to placing topsoil.
2. In areas of poor draining soils prepare subgrades by excavating and removing soil, rock and other construction material to 24 inches minimum below finish grade. Cross-rip subgrades to depth of 6 inches prior to placing topsoil. Retest percolation and modify subgrade until 2 inches per hour percolation is obtained.
3. See Division 31 Section "Earth Moving" for excavation and preparation of subgrades.

D. Place 6 inches topsoil, compost, soil amendments, and fertilizers as recommended in Agricultural Soil Suitability Report per 1,000 square feet and rototill thoroughly to a depth of 8 inches. Compost shall constitute 5% of the amended soil. Place remainder of topsoil, compost, soil amendments, and fertilizers as recommended in Agricultural Soil Suitability Report per 1,000 square feet and rototill thoroughly to a depth of 8 inches, allowing for compaction, natural settlement, and depth of specified mulch.

1. It is the Contractor's option to set up a facility on-site for the preparation and amendment of topsoils, instead of preparing and amending the topsoils in place as indicated in the paragraph above.
2. Set up facility in location as directed by Owner's Representative.

E. Water lightly and allow planting mix to settle. Add additional material at mixture indicated in paragraph above to bring soil level to grades shown on the Drawings with allowance at pavement edges for mulch placement. Provide compaction to 80 percent maximum relative density or as indicated in Division 31 Section "Earth Moving."

F. Meet lines, grades and elevations shown, after light rolling and natural settlement. Fine grade shrub and ground cover areas to smooth even surface with loose, uniformly fine texture. Rake and drag shrub and ground cover areas to remove ridges and fill depressions to obtain firmness and finish grades preparatory to receiving planting.

G. Remove stones over 1/2-inch in any dimension and sticks, roots, rubbish and other extraneous matter.

3.4 SOIL PREPARATION FOR SEEDED LAWNS

A. This article pertains to new lawns and grasses as shown on Drawings and existing lawn and grass areas disturbed by construction activities.

B. Lawn area subgrade preparation:
1. Prepare subgrades by excavating and removing soil, rock and other construction material to 6 inches below finish grade. Cross-rip subgrades to depth of 6 inches prior to placing topsoil.
2. In areas of poor draining soil prepare subgrades by excavating and removing soil, rock and other construction material to 12 inches below finish grade. Cross-rip subgrades to depth of 6 inches, retest and modify subgrade until 2" per hour percolation is obtained, prior to placing topsoil.
3. See Division 31 Section "Earth Moving" for excavation and preparation of subgrades.

C. Place topsoil and compost in 6 inch lifts as recommended in Agricultural Soil Suitability Report per 1,000 square feet. Rototill thoroughly to a depth of 8 inches, tilling topsoil into top 2 inch layer of sub-soil. Place sufficient topsoil allowing for compaction and natural settlement.

D. Place remaining soil amendments, and fertilizers as recommended in Agricultural Soil Suitability Report per 1,000 square feet.

E. Unless otherwise required by the recommendations of the Agricultural Soil Suitability Report apply the following additional soil amendments:

1. Compost: 1 inch minimum depth

F. Incorporate soil amendments into topsoil of lawn areas to a total depth of 4 inches.

G. Leveling Rolling: Drag with flexible tine harrow (or approved equipment) to remove ridges and fill depressions, as required to meet finish grades. Roll areas (minimum roller weight 10 pounds per square inch) in two opposing directions.

H. Repeat rolling procedures and drag lightly to establish a smooth uniform compacted surface free of rocks and other extraneous matter. Provide compaction to 80 percent relative density or as indicated in Division 31 Section "Earth Moving."

I. Water lightly and allow planting mix to settle. Add additional material at mixture indicated in paragraph above to bring soil level to grades shown on the Drawings with allowance at pavement edges. Provide compaction to 80 percent relative density or as indicated in Division 31 Section "Earth Moving."

J. Meet lines, grades and elevations shown, after light rolling and natural settlement. Fine grade lawn areas to smooth even surface with loose, uniformly fine texture. Rake and drag lawn areas removing ridges and filling depressions to obtain firm finished grades for receipt of lawn planting.

K. Remove stones over 1/2-inch in any dimension and sticks, roots, rubbish and other extraneous matter.

L. Finish Grading: Grade lawn areas to smooth, even surface with a loose uniformly fine texture. Finish grade of soil shall be 1/2 inch below adjacent pavement. Limit preparation to areas which will be planted promptly after preparation.

M. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

N. Prior to commencing seeding operations restore seed beds to their finish grade condition if eroded, hardened or glazed or disturbed in any other manner following completion of finish grading. Restoration of seed bed areas shall be considered incidental to the project Work and performed at no additional cost to the Owner.

3.5 WEED ERADICATION FOR SEEDED NATIVE GRASS AREAS

A. Prepare soils for native seeded lawns as indicated in article for seeded lawns unless noted otherwise.

B. Provide "Grow and Kill" for seeded native grass areas: Prior to beginning seeding work, irrigate areas to germinate existing dormant seed within the soil. Set up temporary irrigation system if no permanent irrigation is scheduled for this area. Irrigate daily for a minimum of 7-10 days to germinate seed. Cease irrigation of these areas once seed germination is evident.

C. Spray all weeds, non-native grasses, and existing lawn grasses in areas to be seeded with Post Emergent Herbicide. (This shall be in addition to Post Emergent Herbicide spraying prior to rough grading.) Allow 15 days for complete kill before proceeding with weed removal. Respray until a complete kill is achieved.

D. Remove all dead weeds and grasses by grubbing, tinning and raking at least 1/4 inch below the surface of the soil to be seeded. Remove vegetation from site leaving topsoil in place.

E. Repeat process until no further weed growth is achieved.

F. Maintain the temporary irrigation system for establishment of native seeds. Remove temporary irrigation system after native grasses have been established or as directed by the Owner's Representative.

3.6 SOIL PREPARATION FOR PLANTING PITS OF TREES

A. This article pertains to tree planting when occurring on an individual basis.

1. Backfill Mix: Prepare backfill mix and place in planting pits as specified in Division 32 Section "Plants."
2. Grade smooth to elevations shown.

3.7 SOIL PREPARATION UNDER EXISTING TREES

A. Remove vegetation not indicated to remain beneath canopy of existing trees. Take care not to disturb roots of existing trees.

B. Lightly rake areas and add amended topsoil to meet proposed grades.

3.8 FINE GRADING

A. Finish grade after full settlement including mulch, shall be 1 inch below tops of curbs, walks, or existing grades in shrub areas and 3/4 inch lower in lawn areas.

B. Slope all areas to prevent puddling and drain surface water toward catch basins, drains, curbs, or off-site as shown on Drawings.

C. Soil in all areas shall be thoroughly settled, with a smooth surface free of humps and hollows, and shall be firm enough to resist undesirable impressions when stepped upon.

D. Use levels, screens, drags, or any other equipment necessary to establish and verify grades and surfaces.

E. Finish grade lawn, grass and planting areas to smooth, even surface with loose, uniformly fine texture.

F. Roll, rake, and drag lawn areas, remove ridges and fill depressions with amended topsoil to obtain firmness and finish grades as indicated.

G. Notify Owner's Representative 36 hours in advance to review fine grading of lawn, grass and planting areas. Finish grades shall be prepared to the satisfaction of the Owner's Representative prior to planting.

H. See Division 32 Section "Plants," for mulch placement.

3.9 CLEAN-UP

A. Clean up excess materials and debris from project site upon completion of work or sooner if directed by the Owner's Representative.

B. Leave in neat and tidy condition daily.

3.10 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner’s property.

END OF SECTION 32 9113

SECTION 32 9200 - LAWN AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding.
2. Herbicides.
3. Erosion-control material(s).
4. Seeding of grass pavers.

B. Related sections include the following:

1. Division 32 Section “Soil Preparation,” for topsoil and preparation requirements for new lawns and grasses.
2. Division 32 Section “Lawn Paving,” for preparing soils for infill in grass paver cells.
3. Division 32 Section “Plants” for planting bed border edgings.
4. Division 32 Section “Establishment Maintenance” for maintenance of new plantings after Substantial Completion.
5. Division 33 Section "Subdrainage" for subsurface drainage.

1.2 GENERAL REQUIREMENTS

A. Comply with governing regulations applicable to landscape materials.

B. Do not make substitutions. If specified landscape material is not obtainable, submit to the Owner’s Representative proof of non-availability and material proposed for use as equivalent material.

C. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within seasonal limitations for each kind of landscape work required.

1.3 SUBMITTALS

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

B. Submit the following within 30 days from Award of Contract:

1. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture 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.
2. Vendor’s proof of order for each seed mix specified. Deliver the seed bag tags to Owner's Representative.

3. Fertilizers: Submit manufacturer’s guaranteed analysis.
4. Mulch: Submit samples and vendor's product certificates for top dressing mulch and hydroseed mulch].
5. Certification of each seed mixture for sod, identifying source, including name and telephone number of supplier.
6. Submit copy of herbicide applicator's Commercial Applicator's License to Owner’s Representative before application of herbicides (includes pesticides). Submit a copy of the application record to the Owner’s Representative immediately after each herbicide or pesticide application.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.

1. Installer's Field Supervision: Installer shall maintain an experienced full-time supervisor on the Project site when planting is in progress.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

A. Coordinate work with installation of other site work including irrigation and planting.

B. Verify soil preparation has been completed. Identify conditions not indicated on the Drawings and those which will adversely affect the execution this work. Notify the Owner’s Representative of unsatisfactory conditions immediately.

C. Confirm the irrigation system coverage test has been performed, any required corrections have been completed and the system is fully functional prior to installation of lawns and grasses.

D. Where planting plans indicate non-irrigated seeded areas, the Contractor shall utilize temporary irrigation or other means and methods as approved by the Owner’s Representative, to achieve the Satisfactory Establishment and Warranty requirements as identified within this specification.

E. The Owner’s Representative shall determine areas beyond those indicated on the Drawings which require preparation and seeding due to construction disturbance. This work shall be performed by the Contactor at no additional cost to the Owner.

F. Notify the Owner’s Representative of conditions unfavorable to the propagation and growth of lawn such as; rubble, construction debris, rock fill, glazed soil, hardened soil or adverse drainage conditions before commencing planting or adding soil amendments. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Owner’s Representative.

G. Environmental Requirements: Do not place, spread, or roll fill materials during unfavorable weather conditions. When work is interrupted by adverse weather conditions, do not resume fill operations until moisture content and density of fill are satisfactory.

H. Protection of subgrade: Do not allow equipment to pump or rut subgrade, stripped areas, footing excavations or other areas prepared for the Project. Protect subgrades, fills and excavation areas from surface waters flowing into the work areas.

I. Continuity of Soil Preparation and Seed Application: Prepared soil conditions shall not be allowed to lie fallow. Seeding operations shall commence within 72 hours of approval of finish grading. Should precipitation in excess of 0.25-inches occur within this time period, the soil surface shall be examined upon drying, areas greater than 6-inches in any dimension which are smooth or glazed in appearance shall be re-cultivated. If glazing is evident in multiple portions of the seedbed, the entire bed shall be re-cultivated to establish a friable soil surface. If for any reason, seeding does not occur within the designated 72 hours, the soil shall be re-cultivated and raked prior to seeding to achieve a finish grade condition as identified within the "Soil Preparation" specifications. Any and all re-raking and supplemental cultivation procedures shall be considered incidental to the project Work and performed at no additional cost to the Owner.
   1. Season: Seeding shall take place between April 1st and September 15th, and be performed during normal weather and temperatures appropriate and typical for such work. Non-irrigated areas shall be seeded between April 1st and April 15 or between September 15 and October 1.
   2. Seeding on other dates or during adverse conditions is at the risk of the Contractor and will require additional site inspections to determine seed establishment, areas of seed re-application and the extension of the maintenance and warranty periods as determined by the Owner's Representative. All required inspections, labor & materials to execute this work shall be at the Contractor's expense and performed in accordance with the requirements of this specification section.

1.7 PROTECTION

A. Provide adequate measures to protect workers and passers-by the site. Execute all work in an orderly and careful manner with due consideration for any and all surrounding areas, plantings, or structures which are to remain. Protect all adjacent property and improvements from work damage, and replace any portions damaged.

B. Any structures or facilities damaged due to Work of this Section shall be restored equal to or better than their original condition at the Contractor's expense and to the satisfaction of the Owner's Representative, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 SEED

A. General: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America.

B. Grass Seed Mix: Subject to compliance with requirements, provide the following proprietary seed mixes:

1. Finish Lawn Seed: Hobbs & Hopkins Ltd. “Pro-TimePT 310 Lush Lawn Mix”, Portland, Oregon (503) 239-7518. [Sunmark Seeds International “Celebration Perennial Troutdale, Oregon (503) 241-7333]. Application rate: 8 pounds per 1000 square feet.

2.2 TOPSOIL

A. Topsoil: See Division 32 Section “Soil Preparation.”

2.3 INORGANIC SOIL AMENDMENTS

A. Inorganic Soil Amendments: See Division 32 Section “Soil Preparation.”

2.4 ORGANIC SOIL AMENDMENTS

A. See Division 32 Section “Soil Preparation.”

2.5 TOP DRESSING

A. Top dressing for hand seeding small areas where machine seeding is not feasible (not needed with seeding machine or hydroseeding):

1. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed peat moss, having a water-absorbing capacity of 1100 to 2000 percent.
2. Compost: See Division 32 Section “Soil Preparation.”

2.6 HERBICIDES

A. Post-Emergent Herbicides: EPA registered and approved, of type recommended by manufacturer for selective weed eradication. “Glyphogan Plus Round-Up” by Mana, “Envoy Plus” by Valent, “Crossbow” by Dow AgroSciences, “Landmaster BW” by Agri Star or approved equal.

B. Pre-Emergent Herbicides: EPA registered and approved, of type recommended by manufacturer for selective weed prevention. “Ronstar-G” by Bayer, “Dimension EC” by Dow AgroScience, or equal. Products containing either pendimethalin or DCPA are prohibited.

2.7 FERTILIZER

A. Meet requirements of applicable State fertilizer laws. Fertilizers shall be uniform in composition, dry and free flowing. Deliver to the site in original unopened containers each bearing manufacturer's guaranteed analysis.

B. Composition and rate of fertilizer used to amend topsoil is to be determined by soil analyses. Refer to Division 32 Section “Soil Preparation” for soil fertility testing requirements.

C. Commercial Fertilizer: Slow release, granular fertilizer that is derived from natural organic and inorganic sources.

1. Starter Fertilizer: Woodburn Fertilizer ‘Perfection Mix #29’ 15-15-15 w/Minors, as available from Woodburn Fertilizer, Woodburn; Oregon; Tel.: 1-503 981 3521, or equal
2. Maintenance Fertilizer: Woodburn Fertilizer ‘Regal Green’ 21-4-21 with 50 percent of the nitrogen controlled release from superior Duration™ Type II, as available from Woodburn Fertilizer, Woodburn, Oregon; Tel.: 1-503 981 3521, or equal.
3. Hydroseeding Fertilizer: Nutriculture Super Start® 12-45-10 PLUS Water Soluble Hydroseed Starter, by Plant Marvel Laboratories, Inc., Tel: (708) 757-7500. To be considered for substitution, any “or equal” product shall have a formulation within 2% +/- for N-P-K of the approved product formulation.

2.8 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Peat Mulch: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed peat moss, having a water-absorbing capacity of 1100 to 2000 percent.

C. Compost Mulch: See Division 32 Section “Soil Preparation.”

D. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 2.8 to 6.8.

1. Irrigated Lawns: Profile Products, LLC “Conwed Fibers 2000” or equal.
2. Non-Irrigated Lawns and Grasses: Interlocking crimped polyester fibers combined with wood fibers and cross-linked tackifier, Profile Products, LLC “Conwed Fibers Flexterra HP-FGM” or equal.

E. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application with seed, mulch and fertilizer; nontoxic and free of plant-growth or germination inhibitors.

2.9 EROSION-CONTROL MATERIALS

A. ShortDegradable Erosion Control Blanket: 100% biodegradable 100% agricultural straw stitched with biodegradable thread between two natural fiber nets. Provides effective erosion control for 12months.

1. Available Product: "BioNet" Model S75BN as manufactured by North American Green; Tel.: (800) 772-2040; or equal.

B. Accessories: 6-inch biodegradable staples. "Biostakes" as manufactured by North American Green; Tel.: (800) 772-2040; or equal.

2.10 TEMPORARY BARRICADE MATERIALS

A. Agricultural metal stakes, minimum 42-inch exposed height.

B. Twine or wire.

C. Plastic flagging tape, 12-inch lengths.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with specification requirements and other conditions affecting performance.

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

C. Confirm irrigation coverage test has been performed, all irrigation trenches have been backfilled and compacted and soil preparation has been performed in accordance with procedures outlined in the Soil Preparation specification.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. 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 AREA PREPARATION

A. See Division 32 Section “Soil Preparation.”

3.4 HERBICIDE APPLICATION

A. Spray **[**pre-emergent and post-emergent herbicides as required to eradicate and prevent emergence of noxious weed growth.

1. Apply pre-emergent and post-emergent herbicides over all areas of weed or grass growth within landscaped area to eradicate weed growth. Apply in single application at manufacturer’s maximum recommended rate, as follows:

a. Apply after soil preparation has been completed and approved by Owner’s Representative.
b. Do not till pre-emergent herbicide into soil.
c. Observe manufacturer’s recommended period prior to working and seeding in treated areas.

3.5 HYDROSEEDING

A. Seed lawns with hydroseeding equipment. Method shall be approved by Owner’s Representative.

B. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch with tackifier in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Areas with slope gradient less than 3 horizontal to 1 vertical: Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 2500 pounds per acre dry weight and seed component is deposited at not less than the specified seed-sowing rate.
2. Areas with slope gradient equal or greater than 3 horizontal to 1 vertical: Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 1000 pounds per acre dry weight and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 2000 pounds per acre.

C. Keep hydromulch and seed out of planting beds and off walks, structures and areas not to be seeded. Clean up overspray of hydromulch onto these areas. Keep mulch and seed out of plant beds and other areas by mechanical means or selective herbicide if encroachment occurs. Clean up these areas to the satisfaction of the Owner's Representative.

3.6 EROSION CONTROL NETTING

A. Provide erosion control netting on hand-seeded slopes of gradient greater than 3 horizontal to 1 vertical, and at bottoms of seeded drainage and biofiltration swales. Install netting after applying seed, fertilizer, and mulch.

B. Install from top of slope, working downward, and as recommended by material manufacturer for site conditions.

C. Fasten as recommended by material manufacturer. Secure the netting with 6 inch minimum staples on a 4 foot square grid with one in the middle and an additional staple at the top (1,000 staples per 4,000 square feet). Place top edge of netting in a trench for additional stability.

3.7 LAWN MAINTENANCE

A. Maintain and establish lawn by watering, fertilizing, weeding, mowing, edging, trimming, replanting and other operations necessary to establish a Satisfactory Lawn.

B. The maintenance of all lawns and grasses shall be for a period of 60 calendar days minimum after written Notice of Substantial Completion or until Final Acceptance, whichever is later. Maintenance of seeded lawns and grasses shall commence after observation and approval of the seed bed by the Owner's Representative.

C. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn. Provide materials and installation the same as those used in the original installation.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
2. Protect lawns and grasses from damage including vandalism and adverse weather conditions.

D. Weed Eradication: Remove germinated lawn seed in planting areas without harming other plant material. Spray under and 6 inches outside of fences with "Roundup" to kill all grasses and weeds.

E. If lawns have not achieved a Satisfactory Lawn condition before the dormant period, maintenance shall recommence after the dormant period for a minimum of 60 calendar days and continue until achieving Satisfactory Lawn status. The dormant period is November 15th to March 1st.

F. 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 with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

G. Mowing: Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. All grass clippings shall be collected and disposed of off-site in a legal manner. Schedule initial and subsequent mowings to maintain the following grass height:

1. Finish Lawn: Once growth has reached 4 inches, mow and cut no more than 1/3 total height of grass. Mow weekly thereafter to maintain a height of 2 inches. Maintain until Final Acceptance.

H. Lawn Post-Fertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Fertilize lawns at end of 30 days with Maintenance Fertilizer at the rate of 1 pound per 1,000 square feet.
2. Continue fertilizing lawns at 30 days intervals with Maintenance Fertilizer at the rate of 1 pound per 1,000 square feet until the end of the Maintenance Period.

3.8 SATISFACTORY LAWNS

A. Lawn installations shall have achieved the following Satisfactory Lawn criteria for Final Acceptance; as determined by the Owner's Representative.

1. Satisfactory Seeded Lawn: A healthy, uniform, even colored, dense stand of grass has been established, free of weeds and surface irregularities, humps and depressions, with coverage exceeding 95 percent over any 10 sq. ft. and bare spots not exceeding 2 by 2 inches.
2. Satisfactory Sodded Lawn: A healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Areas of work which do not meet the criteria for Satisfactory Lawns shall be replaced using the specified materials and methods to re-establish lawn. Maintenance shall continue until a Satisfactory Lawn has been achieved.

C. Seeded lawns shall have achieved Satisfactory Lawn status prior to November 15th. Seeded lawns which are not satisfactorily established at this time; as determined by the Owner’s Representative, shall be sodded at no additional cost to the Owner.

3.9 LAWNS AND GRASSES WARRANTY

A. Guarantee all sod, seeded lawns and grasses in writing for a period of 1 year after Final Acceptance, or till the end of one full growing season after date of Final Acceptance, whichever is longer.

B. During and at the end of the warranty period, remove and replace lawns and grasses which are dead, in unhealthy condition or exhibit low germination and growth rates. Provide new lawns and grasses which comply with the Drawings and Specifications, at no additional cost to the Owner. Guarantee replacement lawns and grasses for 1 year from the date of the work.

C. All replacement work shall be executed by the Contractor within 14 days of receiving notification from the Owner's Representative, weather permitting. If repairs are not executed within 14 days, the Owner without further notice may provide materials and labor to perform such repairs at the expense of the Contractor.

3.10 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 temporary fencing or barricades and warning signs as required to protect newly planted areas from foot and vehicular traffic and to protect against trespassing and damage. Maintain fencing and barricades throughout initial maintenance period and remove after lawn is established.

C. Remove non-degradable erosion-control measures after grass establishment period.

END OF SECTION 32 9200

SECTION 32 9300 – PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trees.
2. Shrubs.
3. Ground Cover.
4. Plants.
5. Herbicide.
6. Planting Fertilizers.
7. Erosion Control Matting.
8. Mulches.
9. Root Barriers.
10. Tree Stabilization.
11. Edgings.
12. Planting Accessories.

B. Related Sections:

1. Division 01 Section “Temporary Tree and Plant Protection” for protection of existing trees and plants.
2. Division 31 Section “Earth Moving” for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
3. Division 32 Section “Soil Preparation” for preparation of planting soils.
4. Division 32 Section “Lawn and Grasses" for lawn and meadow planting.
5. Division 32 Section “Planting Irrigation” for irrigation system requirements.
6. Division 32 Section “Critical Areas Restoration, Enhancement and Habitat Improvement” for planting in the restoration areas.
7. Division 32 Section “Establishment Maintenance” for maintenance of plants during the maintenance period.

1.2 REFERENCES

A. Standards: Comply with botanical names, sizes, and conditions provided in:

1. Botanical Names: American Joint Committee on Horticultural Nomenclature, "Standardized Plant Names."
2. Sizes and Conditions: ANSI Z60.1 "American Standards for Nursery Stock", (latest edition).
3. Perennials: "Perennial Plant Association Standards."
4. Native Species: Hitchcock, C.L. and A. Cronquist, "Flora of the Pacific Northwest," 1973.

1.3 QUALITY ASSURANCE

A. Contractor: Provide one person who shall: Be present at all times during execution of work in this section; be familiar with the materials and best methods for installation; direct work performed under this section.

B. Government Inspection: All plants and planting material shall meet or exceed the specifications of Federal, State, and County laws requiring inspection for plant disease and control.

C. Secure plant material and maintain in a climate similar to that of the project site.

D. All plant material to be grown from cuttings or seed. Collected plants are not acceptable.

E. Prior to commencement of any plant installation, an irrigation coverage and pressure test shall have been performed and all required corrections completed. The irrigation system shall be fully operational.

1.4 SUBMITTALS

A. Within 30 days after Contract award, submit:

1. A list of local/regional suppliers for each plant species to be installed. List to include plant quantities, sizes and root conditions. Certify in writing, confirmed orders for plants by submitting a Bill of Sale for each plant to be installed. Each plant species shall be supplied by a single grower only, unless otherwise approved by Owner's Representative. The Contractor shall warrant all plant material to be true to botanical name and specified size.
    a. Submit a separate list of tree suppliers having ample quantities of each species in their specified sizes, with accompanying photos for review by Landscape Architect. Photos shall meet requirements indicated in Section 1.4 - D 2.
        1) Landscape Architect may elect to tag trees in the field following review of this tree submittal. Contractor shall coordinate tree tagging with Landscape Architect prior to purchase of any trees.

    b. Requests for substitutions of plants not available in size, quantity or type specified must be made within 30 days after Contract award. Submit a written summary of specified plants which cannot be obtained.
2. Plant Material Inspection Certificates for all plant material shipped from out of state.
3. 1/2 cubic foot sample of bark mulch for approval prior to delivery.

B. Provide all Product Data submittals simultaneously in a single package for review.

1. Submit product data for the following:

    a. Mulch.
    b. Anti-desiccant.
    c. Post-emergent herbicide.
    d. Pre-emergent herbicide.
    e. Erosion control matting.

f. [Tree stabilization products.]
g.
h. Tree wrap.
i. Mycorrhizal inoculum.
j. Root barriers.

C. Submit copy of herbicide applicator's Commercial Applicator's License to Owner's Representative before application of herbicides (includes pesticides). Submit a copy of the application record to the Owner's Representative immediately after each herbicide or pesticide application.

D. Shrub and Tree Samples:

1. Typical samples, three each of all varieties and sizes (#5 and under for shrubs, #15 and under for trees) of all plant materials shall be submitted for inspection & approval at the site a minimum of fifteen (15) days prior to planting operations. Approved samples shall remain on site and shall be maintained by the Contractor as standards of comparison for plant materials to be furnished. Approved samples shall be incorporated into the work.
2. Tree Photographs: For all trees over #15, submit photographs of each specific tree to be purchased (minimum 2 photos per plant showing differing sides), a minimum of sixty (60) days prior to planting.
   a. Format: Digital, high resolution, color jpeg
   b. Scale: Include a yardstick in each photograph to provide scale.
   c. Background: Ensure form and condition of plant is clearly distinguishable from background.
   d. Identification: On the back of each print and/or as an email attachment, provide the following information:
      1) Name of Project & Owner.
      2) Name & address of Grower.
      3) Date photograph was taken

E. Upon completion of the Work, submit:

1. Written notification to Owner's Representative requesting review for Substantial Completion.
2. Written notification to Owner's Representative of Punch List Completion.

F. With application for final payment, submit:

1. Duplicate copies of delivery invoices, labels, or other acceptable proof of quantities of materials used.
2. Copies of delivery invoices, labels, or other proof of quantities of plant materials and fertilizers.

1.5 SITE OBSERVATION

A. Site observations herein specified shall be made by the Owner's Representative. The Contractor shall provide a minimum of three (3) days notice before Observation is required.

1. Pre-Construction Meeting: Explain Owner Representative's role to Contractor, review construction sequence.
2. Incorporation of soil conditioning and fertilizers into the soil.
3. Application of pre-emergent herbicide.
4. Soil testing after soil preparation for approval to plant.
5. Upon the completion of grading prior to planting.
6. Approval of samples of plant materials delivered to site.
7. When trees and shrubs are spotted in place for planting, but before planting holes are excavated.
8. Plant installation: Check size of planting holes and backfill mix.
9. Verification of finish grades.
10. After planting and all other specified work has been completed.
11. Substantial Completion Inspection and preparation of a Punch List.
12. Maintenance observation after thirty (30) days to coincide with fertilizer application.
13. Final Acceptance Inspection at completion of the Maintenance Period.

B. No site observation visits shall occur until all soil submittals have been made and approved. Construction Observation visits shall be made in proper sequence with the installation of work. The Landscape Contractor shall be responsible for reimbursement of time and travel expenses at current billing rates, incurred by the Architect due to out of sequence site visits.

C. Contractor shall be on site during each site observation visit. Contractor shall speak English.

D. No site visits shall occur until all items in previous Observation Reports have been completed or remedied unless the Owner has waived such compliance in writing.

E. Upon completion of planting and ancillary landscape work, the Contractor shall notify the Owner's Representative in accordance with the procedures outlined in the Substantial Completion Section of this specification.

1.6 QUALITY CONTROL

A. Inspection: Plants shall be subject to inspection by the Owner's Representative at the job site upon delivery to the site. Plants not conforming to specifications shall be rejected and removed immediately from the site.

B. The presence of noxious weeds in plant balls or plant containers shall be cause for rejection of any or all plants from that source.

1.7 DELIVERY

A. Deliver packaged materials to site in original unopened containers bearing manufacturer's guarantee chemical analysis, name, trade name, and trademark.

B. Remove unacceptable plant material immediately from project site.

C. Plant Materials:

1. Deliver trees and shrubs after preparations for planting have been completed, and plant immediately.
2. Do not prune prior to delivery unless otherwise approved by Owner's Representative.
3. Do not bend or bind-tie trees or shrubs in such a manner as to damage bark, break branches, or disfigure natural shape.
4. Provide protective covering during delivery.
5. Protect plants during delivery to prevent damage to root ball or desiccation of leaves.
6. Apply anti-desiccant using a pump sprayer to provide adequate film over trunks, branches, stems, twigs and foliage of plants.
7. If deciduous trees or shrubs are moved in full-leaf, spray with anti-desiccant at nursery before moving, and sprayed again 2 weeks after planting.
8. Label one of each tree and shrub species with securely attached waterproof tag bearing botanical name and supplier's name.

1.8 STORAGE

A. Contractors shall schedule and conduct planting operations to minimize storage of plant materials on the project site. The location and conditions of storage shall be reviewed for approval by the Contractor, Owner, and Owner's Representative.

B. Plants that cannot be planted within 24 hours after arrival shall be "heeled-in" in accordance with accepted horticultural practices and the following requirements:

1. Protect root ball of balled and burlapped plants with moist earth, sawdust or other acceptable material.
2. Protect plants at all times from injury, extreme weather conditions, and keep moist.
3. Store plants in shade at all times and protected from wind until planted.
4. Store plants in upright position and allow sufficient ventilation between plants.

C. All plants that are to be stored longer than one month shall be planted in nursery rows and irrigated using a temporary irrigation system, plants shall be maintained at the Contractor's expense.

1.9 HANDLING

1. Do not drop plants. Do not free-fall, drag, roll or abuse the tree or put a strain on the crown (bud area) at any time.

B. Do not pick up container or balled plants by stems, trunk, or foliage. Handle balled & burlapped plants by the ball of earth.

1.10 NOTIFICATIONS

A. Notify Owner's Representative a minimum of 48 hours in advance of plant material delivery so that plants may be inspected upon site delivery. Unapproved materials are to be immediately removed from the job site.

B. Notify Owner's Representative a minimum of one week in advance for request of Substantial Completion and Final Acceptance inspections.

1.11 SITE CONDITIONS

A. Existing Improvements to Remain: Locate underground utilities prior to start of work.

B. Protect existing improvements from damage, soiling or discoloration. Repair or replace damaged, soiled or discolored improvements as directed by Owner's Representative.

C. Planting Conditions: Planting is not permitted during the following conditions, unless otherwise approved:

1. Cold weather: less than 32 degrees Fahrenheit.
2. Hot weather: greater than 90 degrees Fahrenheit.
3. Wet weather: saturated soil or standing water.
4. Windy weather: wind velocity greater than 20 m.p.h.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. Provide plant materials as scheduled on Drawings.

B. Quantities indicated are for Contractor's convenience only. Contractor to verify and provide number of plants required to complete work graphically shown on Drawings.

C. Sizes and grade quality are maximums as listed. Larger sizes are not acceptable.

D. Plants shall be full foliaged when in-leaf, showing no signs of prolonged moisture stress or over watering as indicated by wilted, shriveled, or dead leaves.

E. Christmas tree stock shall not be used for conifer, evergreen material.

F. Conform to ANSI Z60.1, with additions and exceptions noted:

1. Groundcover Plants: Well-established root systems, and grown in flats or removable containers.
2. Containerized Plants: Grown in container in which delivered for at least 3 months, but not root-bound.
3. Greenhouse Grown Plants: Acclimated outdoors for 360 days prior to delivery.
4. Bare-root Stock: Well-branched, fibrous root system.
5. Balled and Burlapped Plants and Containerized Trees: All evergreen trees and deciduous trees over 1-1/2 inch caliper to be balled and burlapped with hemp burlap and twine only or grown in container in which delivered for 9 months minimum. Soil balls to be a minimum of 10 inches in diameter per caliper inch of tree.

G. Trees shall meet the following requirements:

1. Trunks:
   a. Straight-trunked not varying from plumb more than 6 inches over 6 feet; No fresh cuts over 1 inch diameter, and not "topped" or sheared.
   b. Trees shall have a single, dominant central leader unless a different form is specified in the plant list or drawings. Leader shall have an intact tip and terminal bud at highest part of tree. Main branches shall be 2/3 or less than diameter of the central leader, measured 1" above the branch union.
   c. No flush cuts, sunscald or branch stubs
   d. No open trunk wounds
   e. Trees with visible suckers or lower shoots or, evidence of suckers and lower shoots removed are not acceptable.
2. Branches:
   a. Well-branched, with no cross branches, vertical branches, large branches directly above another, or co-dominant leaders.
   b. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.
   c. Main branches shall be radially and vertically distributed along the central leader and not clustered together. They shall form a balanced crown appropriate for the cultivar/species.
   d. Shoot growth (length and diameter) throughout the crown shall be appropriate for the age and size of the species or cultivar.
3. Canopy and Leaves:
   a. Tree canopy shall be full with healthy foliage evenly distributed around the tree.
   b. Tree leaves free of spotting, blotching, chlorosis and die back inconsistent with seasonal change.
4. Roots:
   a. Root collar (flare) within 2" above soil surface for B&B trees.
   b. Root collar within 1" of soil mass for containerized trees.
   c. Structural roots (roots over 1/10 diameter of trunk) shall radiate in all directions and reach the side of the rootball. No circling, kinked, or bottom-matted structural roots.
   d. At time of delivery and inspection, rootball shall be moist throughout.
5. Grafted Trees: Base grafted or budded only.
6. Trees in formal arrangements and rows:
   a. Provide trees matched in height and spread with less than 1' of variation.
   b. Trees shall have less than 6" in variation in clear branching height.
   c. Coordinate tagging of trees in the fall to confirm coordinated fall color.
   d. Confirm desired characteristics of formal tree arrangements with Landscape Architect.

2.2 HERBICIDES

A. Post-Emergent Herbicides: EPA registered and approved, of type recommended by manufacturer for selective herbicide application. "Round-Up," or approved equal.

B. Pre-Emergent Herbicides: EPA registered and approved, of type recommended by manufacturer for selective weed prevention. “Ronstar-G” by Bayer, “Dimension EC” by Dow AgroScience, or equal. Products containing either pendimethalin or DCPA are prohibited.

2.3 PRE-PLANT FERTILIZER

A. (1-10-10) shall be a combination of natural organic and inorganic granular fertilizers, free-flowing, and shall contain the following minimum available percentage by weight of plant food:

Nitrogen	1.0% minimum
Phosphoric Acid	10.0% minimum
Potash	10.0% minimum

2.4 POST-PLANT FERTILIZER

A. (7-9-4) shall be a long-lasting, organic and controlled release plastic-coated, uniform in composition, free-flowing and shall contain the following minimum available percentages by weight of plant food.

Nitrogen	7.0% minimum
Phosphoric Acid	9.0% minimum
Potash	4.0% minimum

2.5 MULCH

A. Provide standard, commercially produced, medium-course, dark brown, bark mulch. Bark shall be ground Fir or Hemlock bark of uniform color, free from weeds, seed, sawdust, and splinters and shall not contain resin, tannin, or other compounds detrimental to plant life. All material shall pass a 1 inch mesh screen.

2.6 ANTI-DESSICANT

A. Emulsion type, film-forming agent designed to permit plant transpiration but retard excessive loss of moisture from plants. "Wilt-Pruf" or equal.

2.7 PLANTING SOIL MIXES

A. Refer to Division 32 Section “Soil Preparation.”

2.8 EROSION CONTROL MATTING

A. Erosion Control Blanket shall be 100 percent coir twines with no seams. Matting shall be sisal jute mesh of uniform open weave, single jute yard, chemically treated to be fire-retardant. The blanket shall be Ludlow ‘Soil Saver’; Belton Industries;

'Geojute'Geocoir/DeKoWe 700 or equal with the following minimum average roll properties:

1. Thickness 0.35 inches (ASTM D1777).
2. Average Tensile Strength 1450 lbs/ft (ASTM D4595).
3. Weight 14.7 oz/sy (ASTM D3776).
4. Open Area 60percent (measured).
5. Warp 78 per width, minimum. Weft 42 per linear yard, minimum.
6. Roll Width 6.5 and 9.8 feet (measured).
7. Roll Length 165 feet minimum (measured).
8. Color natural earth tone .

B. Wooden Stakes: Untreated Douglas fir 3/4 x 1/2 x 18 inch wood stakes.

C. Staples: Manufacturer's recommended steel wire staples, 6 inches long, 11 gage galvanized steel.

2.9 TREE STAKING AND GUYING

A. Deciduous Tree Tie: Black plastic chain-type, minimum 1 inch wide by 1/8 inch thick.

B. Evergreen Tree Guy Wire: 12 gauge galvanized wire with 1/2 inch rubber hose collar, black color, to protect tree trunk.

C. Stakes: 2 inch x 2 inch x 8 feet Douglas fir for staking of deciduous trees; and 2 inch x 2 inch x 36 inch Douglas fir for guying of coniferous trees. Stain brown with water-based commercial wood stain prior to installation.

D. Provide miscellaneous hardware, wire, and accessories as shown on the Drawings.

E. PVC Flags: 1/2 inch or 3/4 inch diameter x 36 inches long PVC pipe.

2.10 SUBSURFACE TREE STABILIZATION

A. Cable: 10 gauge multi-strand steel wire with 1/2 inch rubber hose, black color, to protect tree rootball.

B. Deadman: 6 inch x 6 inch x 4 feet Concrete plank.

C. Provide eye bolts for anchoring cable to deadman, miscellaneous steel hardware, and accessories as shown on the Drawings.

2.11 BROWSING PROTECTORS

A. Provide 4 inch x 24 inch Photo-degradable Rigid Seedling Protection Tubes (Product Number ADC 1085). Available from Terra Tech in Eugene, OR (800) 321-1037.

B. Provide minimum 8-10 mm diameter, 3 foot length Bamboo Stakes (3 per Tube).

2.12 TREE WRAP

A. Corrugated or crepe paper, designed specifically to resist insect infestation and sun scald.

2.13 MYCORRHIZAL INNOCULUM

A. Available Products:

1. 'MycoApply All Purpose Granular' granular mycorrhizal inoculum. Available from: Mycorrhizal Applications, Inc., Grants Pass, OR (541) 476-3985.
2. 'PHC Plant Saver' blend of ecto and endomycorrhizal fungal spores, beneficial rhizospere bacteria, 4-7-4 fertilizer, organic amendments, and micronutrients. Available from Plant Health Care, Inc. (800) 421-9051.
3. Or equal.

2.14 ROOT BARRIERS

A. Rigid interlocking polypropylene panels: Deep Root, Inc; or equal.

1. Root control barriers: 24 inches deep by 0.08 inch thick polyethylene panel with integral root directing ribs and self locking joiner strips. Model No. UB 24-2.

2.15 EDGINGS

A. Shovel Cut: As shown on Drawings.

2.16 DRAINAGE ROCK BACKFILL

A. 1-1/2 to 1/2 inches round washed river rock; no fines for non-percolating soil.

2.17 FILTER FABRIC

A. Non-woven filter fabric to cover drain rock: Mirafi 140N as available from TenCate, (360) 699-1426; Propex 451 as available from A.C.F. West Inc., (503) 771-5115; or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify finish grades are properly achieved and soil preparation has been completed in accordance with the specifications; start of Work denotes acceptance by the Contractor and Contractor assumes responsibility for final results.

3.2 SOIL PREPARATION

A. As specified in Division 32 Section “Soil Preparation”.

3.3 HERBICIDE APPLICATION

A. Spray pre-emergent herbicide as required to eradicate and prevent emergence of noxious weed growth.
   1. Apply a mixture of pre-emergent and post-emergent herbicides over all areas of weed or grass growth within landscaped area to eradicate weed growth. Apply in single application at manufacturer’s maximum recommended rate, as follows:
      a. Apply after soil preparation has been completed and approved by Owner’s Representative.
      b. Do not till pre-emergent herbicide into soil.
      c. Observe manufacturer’s recommended period prior to working and planting in treated areas.

3.4 EROSION CONTROL MATTING

A. Provide erosion control blanket on slopes of gradient 3 horizontal to 1 vertical and greater. Install blanket after soil preparation and prior to planting.

B. Install erosion control matting after preparing soil and finish grading. Matting shall lie loosely in full contact with the soil without any tension.

C. Install from top of slope, working downward, and as recommended by material manufacturer for site conditions.

D. Fasten as recommended by material manufacturer if more stringent than these specifications. Provide temporary wood stakes as required. Remove wood stakes after planting and blanket has been securely stapled to the slope.

E. Secure the blanket with 6 inch minimum long staples on a 4 foot square grid. Tops, bottoms, and joints of matting shall have staples driven in at 12-inch centers.

F. Top of each length of erosion control matting shall be anchored in a 6 inch deep trench and shall terminate at the slope bottom with a 6 inch fold turned under. Adjoining lengths of matting shall have 6 inch minimum overlap.

G. Cut "X" slits into matting to plant trees and shrubs. Fold matting back around plants and staple to hold in place.

3.5 LAYOUT

A. Mark locations of lines between the planting areas and the lawn areas on the finish with paint, chalk or equal material for approval by the Owner’s Representative. The method of marking shall be approved by the Owner’s Representative.

B. Mark locations of trees and shrubs for approval by the Owner’s Representative prior to digging. The method of marking shall be approved by the Owner’s Representative. After approval of layout, field place trees and shrubs in locations shown on Drawings. Owner’s

Representative may request rotation or slight movement of tree to give a better appearance with respect to adjacent plants and structures. Placement must meet approval of Owner's Representative prior to excavating planting pits.

3.6 EXCAVATION FOR TREES AND SHRUBS

A. Excavate planting holes, with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

B. For trees and shrubs, make excavations at least 2 times wider than root spread; equal to the rootball height directly beneath the rootball; and 1-1/2 times deeper than rootball height around the perimeter of the planting pit, as indicated in the Drawings.

C. If non-percolating soils are encountered, fill excavations for trees and shrubs with water and allow to percolate out before planting. If plant holes do not drain: Auger drill holes 36 inches deep by 8 inches wide and fill with drainage backfill. Cover top with filter fabric. Notify Owner's Representative to observe prior to planting.

D. If conditions detrimental to plant growth are encountered, such as rubble fill, or obstructions, notify Owner's Representative and resolve before planting.

E. Scarify bottom and sides of hole with shovel to eliminate "glazed" surfaces.

F. Set plants on native soil where possible.

3.7 PLACING

A. Set top of root ball 1 inch higher than finish grade. If hole for trees is too deep, fill hole with native soil only where applicable or prepared soil to correct levels.

B. Set plants plumb and faced for best appearance.

C. Remove wire baskets, burlap or fasteners from rootball completely if rootball will not be damaged. If damage is suspected, notify Owner's Representative for concurrence and remove tops and sides of baskets minimum. Use bolt cutters on wire if necessary to remove wire baskets. Bending back not acceptable. Remove all burlap and twine from planting pit.

D. Remove metal cans or plastic containers completely from rootball.

E. Neatly cut off broken, girdling, or frayed roots and any root growth growing in a circular manner conforming to its container.

3.8 BACKFILLING - General

A. Before mixing, clean topsoil of extraneous materials and other materials harmful or toxic to plant growth.

B. Prepare planting backfill soil mix prior to backfilling. Stockpile on site.

C. Planting backfill soil mix shall be as follows: [1/4] compost material, [1/4] amended topsoil and [1/2] soil excavated from planting pit.
   1. For the following group of plant materials, include peat moss as part of the backfill mix: Azalea spp., Camellia spp., Kalmia spp., Pieris spp., Rhododendron spp.
   2. The modified backfill mixture schedule for these plants shall be of the following ratio:
      a. [1/4] compost material, [1/4] topsoil, [1/4] peat moss and [1/4] soil excavated from planting pit.

D. Backfill half of plant pit around rootball with backfill soil mix, carefully tamp soil around rootballs.

E. Add 3 ounces mycorrhizal inoculum per caliper-inch to backfill around trees. Add 3 tablespoons mycorrhizal inoculum per gallon planting size. Add 1 teaspoon mycorrhizal inoculum per ground cover plant.

F. Complete backfilling, firming to surface grade.

G. Form watering basin from site topsoil as shown on Drawings.

H. Thoroughly hand water each plant and entire bed immediately after planting. Adjust rootball and soil as required if settlement of soil occurs.

I. Remove plant tags and ribbons.

3.9 PLANTING TREES AND SHRUBS

A. Set roots or rootball on layer of compacted planting soil backfill mix or native suitable topsoil from planting pit, plumb and in center of pit or trench with top of rootball at 1 inch above elevation of adjacent finished grade.

B. Place additional planting soil backfill mix around base and sides of ball and eliminate voids and air pockets. When backfill is approximately 2/3 complete, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill. Cut burlap from top of rootball and roll back to sides of planting hole; form watering basin; stake and guy immediately after planting.

C. After planting, apply fertilizer at the following rates:
   0-1 foot tall shrub = 0.4 oz.
   1-2 foot tall shrub = 0.8 oz.
   2-4 foot tall shrub or tree = 1.75 oz.
   4-8 foot tall shrub or tree = 4 oz.
   8+ feet = 4 oz. plus proportional amount per foot.

3.10 PLANTING GROUNDCOVER

A. Space plants as shown or scheduled on Drawings. Dig holes 3 times the width and 1-1/2 times the depth of the rootball. Plant with planting soil backfill mix. Work soil around roots to eliminate air pockets. Water thoroughly after planting.

B. After planting, apply fertilizer at the rate of 50 pounds per 1,000 square-feet, or apply 1 slow-release fertilizer tablet per plant during backfill.

3.11 ROOT CONTROL BARRIERS AT NEW PLANTINGS

A. Provide linear and surround root barrier applications at trees within 5 feet of paving, curbs, walls, utility ducts or other appurtenances.
   1. For linear applications provide sufficient lengths of panels to equal mature width of tree canopy plus 2 feet, 10 feet minimum length. Provide on both sides of the tree trunk adjacent to curb and paving per manufacturer's recommendations.
   2. For surround applications provide a minimum of five 24-inch long panels where trees are planted on an individual basis. Shape connected panels to form an oval around the tree rootball.

B. Excavate planting hole as specified for tree planting.

C. Begin backfilling with soil mix and install tree as specified. Backfill up to depth equal to depth of root control barrier panel. Install interlocking root control panels around rootball, with minimum 8 inches clearance to rootball and with top 1/2 inch above finish grade.

D. Backfill around rootball with planting soil backfill mix as specified for tree planting. Backfill outside of root control barriers with 3/4 to 1-1/2-inch crushed gravel, no fines (not pea gravel), to full depth of panels and minimum 4 inch wide area.

3.12 LINEAR ROOT CONTROL BARRIERS AT EXISTING TREES

A. Provide at locations shown on the Drawings and as approved by the Owner's Representative. Excavate 24 inches deep trench along edge of proposed pavement. Install trench and barrier prior to pouring concrete or laying of pavers. Re-compact pavement subgrades and bases encountered during installation of root barriers. Cut any existing roots squarely according to standard horticultural practices and root barrier manufacturer's recommendations.

B. Install panels vertically, with ribs on tree side of barrier, to be flush against proposed paving, maximum 2 inches below top of paving, and 1/2 above finish grade. If panels cannot be installed immediately against paving formwork, backfill paving side of panel with 1-inch minus crushed rock to keep panel vertical and stabilized.

C. Provide minimum 10-foot length of connected panels, centered on tree trunk or existing root, as directed by Owner's Representative. Backfill tree side of barrier with planting backfill soil mix. (See "Planting Trees and Shrubs" article above.)

3.13 TRUNK WRAPPING

A. Deciduous trees over 1-1/2 inch caliper when within five feet of pavement shall be wrapped promptly after planting to prevent sun scald, wrapping as approved by American Association of Nurserymen. Wrap spirally from ground line to the height of the first branch. Wrap in neat and snug manner and secure with tape similarly colored to tree wrap at bottom, top and in the middle. Wrap before staking or guying.

3.14 STAKING

A. Deciduous Trees 1-inch caliper and larger: Provide 2 stakes per tree 180 degrees from each other in the direction of prevailing winds. Drive plumb outside of rootball as shown on Drawings. Place tree ties around tree trunk, approximately 4 feet from ground level, one from each side.

B. Coniferous Trees 4 feet tall and larger: Provide 3 guys evenly spaced around trunk of tree. Set guys at a 60 degree angle to the trunk at 2/3 the height of the tree. Drive 2 by 2 inch wood stakes perpendicular to angle of cable. Secure guys taunt at trees passing each guy wire through a collar and setting the collar at the tree trunk where contact is made. Secure a warning flag on each cable as shown on Drawings.

3.15 MULCH

A. Place mulch by hand, blown-in mulch is not acceptable unless approved by the Owner's Representative. Place mulch **3** inches deep in all planting beds. Rake smooth. Mulch shall be pulled away from crowns of shrubs, perennials and groundcover plants. Mulch shall be flush with adjacent curbs and paving. Taper mulch thickness from full **3**-inches depth to **2**-inch depth over a 12-inch horizontal run at paving edges so mulch will be flush with adjacent curbs and paving.

B. Tree Plantings in Lawns:

1. Deciduous Trees: Cut away and remove lawn to establish a 4-foot radius circle from center of tree. Cut clean edge and fill with mulch.
2. Coniferous Trees: Cut away and remove lawn to establish a circular ring 2 feet beyond the outside dimension of drip line of tree. Ring to be centered on tree minimum 4-foot radius. Cut clean edge and fill with mulch.
3. For trees in pavement cut outs, provide minimum 3 inches depth of mulch.

C. Ground Cover Plantings:

1. After fertilizing, mulch areas between groundcover plants; place minimum 3-inch depth of specified mulch.

3.16 PRUNING

A. Prune plant material if necessary and as directed by Owner's Representative to balance root and top growth. Prune, thin, and shape trees and shrubs in accordance with standard horticultural practices.

B. Prune all dead and broken limbs.

C. Prune without distorting basic form of the plant and only to the extent necessary for each plant except where directed by Owner's Representative. Do not prune plants into boxes or balls.

3.17 CLEAN-UP AND PROTECTION

A. During landscape work, keep pavements clean and work area in an orderly condition.

B. Sweep and wash paved surfaces to remove soil and soil stains.

C. Clean all mud and debris from catch basins, which is caused by Work of this Section.

D. Remove plant containers, trimmings, clippings, and all extraneous debris unearthed or resulting from any operations specified herein, from Project Site and dispose in a lawful manner.

E. Protect landscape work and materials from damage.

F. Maintain protection during installation and Maintenance Period.

G. Treat, repair or replace damaged Work as directed by Owner's Representative, at no additional cost to the Owner.

3.18 SUBSTANTIAL COMPLETION

A. Notify the Owner's Representative in writing of the completion of planting and ancillary landscape work.

B. Within 10 days of notification, the Owner's Representative will inspect the work and prepare a Notice of Substantial Completion with a Punch List identifying items which require completion or correction.

C. Notice of Substantial Completion constitutes the commencement of the Maintenance Period and the Warranty of all plants for a period of One Year.

D. The Contractor is responsible for maintaining all plants prior to receiving Notice of Substantial Completion.

3.19 MAINTENANCE

A. After receiving notice of Substantial Completion, maintain all plant material in a vigorous condition according to the requirements outlined in Division 32 Section "Establishment Maintenance" and through any extensions of the Maintenance Period due to failure to supply written documentation of Punch List completion. Maintenance shall continue until Final Acceptance is granted.

B. If plants are not installed before the dormant period, (November 15th to March 1st), maintenance shall recommence after the dormant period for **90 days**following their installation or until Final Acceptance, whichever is later.
   1. Inspect plants at least once a week and perform maintenance promptly.
   2. Maintain trees, shrubs and ground covers by watering, pruning, spraying, cultivating, and weeding as required for healthy growth.
   3. Water when soil moisture is below optimum level for best plant growth.

4. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required.
5. Eradicate all weeds, grass, and other undesired vegetation growth from planting areas. Remove dead weeds and dispose of legally off-site. Remove all perennial weeds completely, including all underground parts.
6. Restore all soil settlement to original grade.

C. Immediately remove and replace plant material which is dead, not surviving or in poor condition during the Warranty Period at no cost to the Owner.

D. Plants used for replacement shall be the same variety as originally specified. Replacement plant size shall match the physical size of the adjacent, healthy plants of the same species at the time of replacement. Replacement plants shall be furnished, planted and fertilized as originally specified.

E. Should a dispute arise concerning plant vitality or viability, the Contractor shall provide at his expense, a timely written diagnosis of plant health by a Certified Arborist. The Arborist's report shall indicate reason for lack of vigor, potential remedies, if any, and estimated time required to regain vigor and specified size. Contractor shall repair at no additional cost to the Owner, all damage to vegetation, site improvements and property caused by replacement of plant materials during the Maintenance Period.

F. Store maintenance materials and equipment where directed by Owner's Representative.

G. Keep pavements clean and work areas in an orderly condition.

H. Fertilizing and Liming: Perform as recommended in the soil fertility analysis reports and as necessary to maintain cover crop in a healthy growing condition.
1. Fertilize trees, shrubs and ground cover once at the end of the Maintenance Period. Work the fertilizer thoroughly into the top 2 inches of soil.
2. In March, within the first growing season, fertilize all planting areas with 1 application of each of the maintenance fertilizers, at the rate of 7 pounds per 1,000 square feet of soil surface.

I. Hand-water plant material to supplement irrigation as needed for a period of 1 year.

3.20 FINAL ACCEPTANCE

A. Final inspection of all planting will be made by the Owner, Owner's Representative and the Contractor.

B. Prior to executing a final inspection, the Contractor must furnish the Owner's Representative with written documentation identifying how each Punch List item has been corrected. If such written documentation is not provided to the Owner's Representative, all requirements of the Maintenance Period shall remain in force indefinitely until the written documentation is provided. Any extension of the Maintenance Period will be considered incidental to the Work, and performed by the Contractor at no additional cost to the Owner.

C. Before Final Acceptance is granted, the following must be completed by the Contractor and receive approval from the Owner's Representative:

1. Written documentation identifying how each item on the Punch List has been corrected.

2. Replacement planting and correction of all items identified on the Punch List prior to expiration of the specified Maintenance Period.

D. The project site must meet all conditions stipulated within the "Maintenance" and "Clean Up and Protection" sections of the specifications.

E. If Final Acceptance is not granted at the end of the specified Maintenance Period, the Contractor shall continue maintaining plantings until Final Acceptance is granted, at no additional cost to the Owner.

F. Necessary Observations Beyond Final Acceptance:

1. If any of the items identified on the Notice of Substantial Completion and Punch List have not been fully corrected or repaired to the complete satisfaction of the Owner's Representative, the Contractor must schedule a field observation to substantiate claim of correction. The Contractor shall bear financial responsibility to reimburse the Owner for all time and travel costs incurred by the Owner's Representative to confirm Punch List compliance.

END OF SECTION 32 9300

SECTION 32 9500 - ESTABLISHMENT MAINTENANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Work of this section includes all labor, materials, equipment and operations to maintain all installed work as specified herein and as noted on the Drawings.

1. Maintenance of all installed work for **1** years from the date of Substantial Completion.

B. Related Sections:

1. Division 32 Section “Soil Preparation” for preparation of planting soils.
2. Division 01 Section “Temporary Tree and Plant Protection” for pruning of plants and trees.
3. Division 32 Section "Lawn and Grasses" for lawn and meadow planting.
4. Division 32 Section “Plants” for trees, shrubs and ground cover plantings.
5. Division 32 Section “Plants” for mulches and tree stabilization.
6. Division 32 Section “Planting Irrigation” for irrigation systems.
7. Division 32 Section “Critical Areas Restoration, Enhancement and Habitat Improvement” for planting in the restoration areas.

1.2 OWNER'S RESPONSIBILITY

A. Water: Owner will pay for water used for irrigation after the date of Substantial Completion.

B. Power: Owner will pay for power used by irrigation controllers after the date of Substantial Completion.

1.3 SUBMITTALS

A. Submit product Data and certificates showing compliance with EPA and listed under the Oregon State University “Low-Impact Pesticide List” (OSU School IPM Program)where applicable for the following:

1. Fertilizers, including application rates.
2. Herbicides, including application rates
3. Pesticides, including application rates.

B. Submit a Maintenance Schedule indicating frequency and type of maintenance work to be performed at each visit for the duration of the Maintenance Contract complying with the requirements of this Section.

C. Submit a Weed and Pest Control Plan for approval at least 30 days prior to Substantial Completion of the Work.

D. Submit a copy of the maintenance log at two-week intervals for the duration of the Project.

1.4 MAINTENANCE AND WARRANTY PERIOD REQUIREMENTS

A. All plant materials shall be maintained in a healthy condition until the end of the Maintenance and Warranty Periods. Replace dead and unhealthy plants immediately.

B. All plant materials and equipment replaced under warranty shall be replaced in accordance with all provisions of the Contract Documents. Equipment shall be of the same manufacturer, model, size and quantity as originally installed. Plant material shall be of the same variety, size, and quantity as originally installed.

1. Owner reserves the right to inspect plant materials replaced under warranty and reject those which do not conform to specified standards.

C. All athletic fields shall be maintained in a healthy vigorously growing condition until the end of the Maintenance and Warranty Periods.

1. Seed bare spots every 2 weeks until specified density is achieved.
2. The Contractor is responsible to achieve and maintain a “broadleaf free” stand of turf before turning over to the Owner. If not achieved, responsibility lies on Contractor to achieve required establishment at no additional expense to the Owner and extend maintenance until the desired stand is achieved, as determined by the Owner’s Representative.
3. The Contractor is responsible to provide a dense healthy stand of turf that has specified turf species and reasonably free of undesired turf species (one undesired plant per 2,500 square feet) before turning over to the Owner. If not achieved, responsibility lies on contractor to achieve goal at no additional expense to owner and extend maintenance until desired stand is achieved, as determined by the Owner’s Representative.
4. Maintenance Notification: Notify Owner's Representative in writing 14 days minimum prior to end of Maintenance period and the Owner's assumption of maintenance responsibilities. The Owner will accept maintenance responsibility for lawn and grass areas following Final Acceptance of entire project.

D. Schedule included in this Section indicates task minimums. Contractor may perform tasks at greater frequency to comply with Contract requirements.

1.5 WEED and PEST CONTROL PLAN

A. Contractor shall submit a Weed and Pest Control Plan for approval at least 30 days prior to Substantial Completion of the work.

1. The Weed and Pest Control Plan shall define all scheduled applications of herbicides and pesticides as required herein. It shall identify the applicator and license number,

the names of the herbicide and pesticide products, along with the location, rate, frequency, season and method of application.

2. The Contractor may submit for pre-approval the use of herbicides and pesticides to be applied on an as needed basis in anticipation of probable weed growth or infestations.
3. No herbicides or pesticides shall be applied until Weed and Pest Control Plan is approved and all applications shall be in accordance with the plan.
4. If unanticipated weed growth or infestations occur, the Contractor shall be required to modify Weed and Pest Control Plan and secure written approval of Owner and Owner's Representative prior to application.
5. The Owner and Owner's Representative shall review and approve the plan.

B. All applications of herbicides and pesticides shall be performed by an Oregon State licensed commercial applicator. All precautions shall be taken in the handling and applications of all herbicides and pesticides as stated on the product label and in the Pacific Northwest Weed Control Handbook, latest edition. No contamination of vicinity water systems or storm drain systems allowed. No cleaning of equipment or disposal of products allowed in project vicinity.

1. All products shall be approved through client’s IPM coordinator for use on public property.
2. Posting prior application to be performed in accordance with clients IPM plan and the responsibility of contractor.

PART 2 - PRODUCTS

2.1 GENERAL

A. All products shall be as specified in the appropriate Specification Sections.

B. Use Slow release fertilizer: 21-4-21 with 50-65% slow release nitrogen or equal for athletic fields.

PART 3 - EXECUTION

3.1 GENERAL

A. Inspection: All grounds will be inspected weekly throughout the maintenance period for weeds, pests, plant health, erosion, paper and debris.

B. Pest and Disease Control:

1. Inspect all plants for signs of pest or disease once per week during the growing season and report any such conditions in the monthly report.
2. Begin treatment for pests or diseases immediately following observation.
3. Pest and disease control shall be carried out by skilled operators, using methods approved under current laws and regulations.

4. Use the recommended type of equipment and method of application for each chemical as recommended by the chemical manufacturer.
5. All chemicals shall be mixed and applied as stated on the label of the manufacturer.
6. Be extremely cautious in the mixing, handling and application of all chemicals as they may be harmful (if misused) to humans, plants, and animals.
7. The Contractor shall be liable for any damage caused through the misuse of any plant disease or plant insect control method.
8. Rodent Control: The Contractor shall take the necessary action to prevent damage by rodents and moles. Such damage that does occur shall be repaired by the Contractor.

C. Watering:

1. An irrigation system will be installed on this Project. The Contractor shall ensure that the irrigation system is in an operating condition throughout the period of this Contract.
2. Coordinate and manage the irrigation controller so that appropriate amounts of water are applied based on season, weather condition and plant material.
3. The Contractor is responsible for conserving water as much as possible by adjusting heads for overthrow, appropriate settings for water infiltration, and limiting runoff.

3.2 LAWN AREA OPERATIONS

A. Fine Mowing:

1. For all Lawn areas the Contractor shall inspect and police the grounds for litter and debris prior to each mowing, and dispose of it.
2. All Lawn is to be mowed every 7 days beginning in April and through the end of September, with an additional two mowings in October, November, December, February and March as needed.
3. Mowing height for all irrigated lawn areas shall be no less than 1-1/2inches, not to exceed 2-1/4 inches between mowing operations.
4. Mowing height for non-irrigated lawn areas shall be not less than 3 inches, not to exceed 6 inches between mowing operations.
5. The lawn shall be cut at a uniform height, with reel mowers in open areas and rotaries in closed areas. Scalping and uneven cutting shall be prevented. Any excess clippings shall be dispersed and/or collected to prevent damage to existing lawn areas or if it causes an unsightly appearance.
6. Mower blades shall be maintained in a good condition for an even cut. Mower blades shall be cleaned prior to entering site to prevent dispersal of weed seeds picked up from off site.
7. Contractor shall repair or replace all trees, shrubs and other plantings and other permanent fixtures that are damaged during mowing operations. Mowing equipment will be adjusted and maintained to provide the best possible cut.

B. Edging: All sidewalks, curb lines, concrete slabs, bed edges shall be edged as needed to maintain a neat, clean appearance, once every three mowings (minimum).

C. Hand Trimming: Trimming shall be performed around all road signs, guard posts, trees, shrubs, utility poles and other obstacles. The grass to be trimmed shall be trimmed no less

than the desired height of cut determined by the mowing operation. Trimming is to be done with each mowing operation.

D. Lawn Fertilization:

1. Fertilizing and Liming: Perform as recommended in the soil analysis reports submitted under Division 32 Section "Soil Preparation," and as necessary to maintain cover crop in a healthy growing condition.
2. Application of fertilizers carried out by the Contractor to maintain proper nutrient levels and provide a consistent dark green lush appearance throughout the maintenance period. Lawn shall be fertilized a minimum of 1 time per maintenance period applying 8 pounds of nitrogen per 1,000 square feet, to maintain a consistent, lush green appearance.
3. Deficiencies of sulfur or magnesium or other nutrients as determined by soil analysis shall be corrected as needed. Timing of these applications may vary according to the need for response.

E. Weed Control:

1. Inspect Lawn areas for weed growth twice per month during the growing season and remove all weeds within one week of observing weed growth.
2. Maintain all areas in a weed free condition.
3. The application of herbicides on all mowed lawn areas shall be done according to the approved Pest and Weed Control Plan. One application with follow-up applications as required to maintain a kill of 90 percent of broadleaf weeds shall be required.
4. Pre-emergent herbicides to be used to control specific annual grasses, such as annual bluegrass and crab grass.
5. Weed control procedures shall have no detrimental effect on the growth of desired plants.

F. Re-Seeding: Upon detection of damaged or failing areas and areas showing unsatisfactory growth and coverage, the restore the area as necessary to establish a complete cover crop. Reseed using the seed mixes specified.

G. Clean Walks: At the conclusion of each visit, walks adjacent to work areas are to be cleaned.

H. Leaf Removal:

1. Removal of all leaves from all lawns, planter beds and walkways and their disposal offsite shall be completed throughout the maintenance period as needed to maintain a clean appearance throughout the Project.
2. Main entries, high traffic areas, and walkways shall be cleaned weekly. All other landscape areas are to have complete leaf removal monthly, during October, November and December.

I. Aeration of Lawn Areas: Aeration is an extra service, to be performed as needed with Owner's authorization.

3.3 ORNAMENTAL PLANTING AREAS

A. Fertilizing:

1. Fertilizing and Liming: Perform as recommended in the Soil Analysis reports and recommendations, and as necessary to maintain cover crop in a healthy growing condition. See Division 32 Section “Soil Preparation.”
2. Fertilizing of all trees, shrubs and ground cover is to be done once at the end of the maintenance period. Work the fertilizer thoroughly into the top 2 inches of soil.
3. In March, within the first growing season, fertilize all planting areas with one (1) application of each of the following fertilizers, all at the rate of 7 pounds per 1000 square feet of soil surface:

    a. Nitroform slow release (38-0-0)
    b. Treble superphosphate (0-45-0)
    c. Sulphate of potash (0-0-50)

B. Weed Control:

1. All planter beds, tree circles, sidewalk cracks, and pavers, are to be sprayed once per month to control unwanted grasses and broadleaf weeds according to approved Pest Control Plan. Chemical practices shall not be a substitute for hand-weeding where the latter is required for complete removal.
2. All planter beds are to have one application of pre-emergence herbicide at the end of the maintenance period. Pre-emergence herbicides shall be of the non-leaching type, with minimal soil contaminating levels. Pre-emergence herbicides shall not be used in groundcover areas unless approved by the Owner’s Representative.

C. Pruning: done to enhance natural growth. The Contractor shall remove dead, damaged and diseased portions of the plant. Do not remove collar at the branch base when pruning. All major pruning shall be done following flowering or during plant's dormant season. Emergency or minor pruning shall be done when needed. Pruning of trees shall be performed by a certified arborist.

1. Shearing of plantings will be permitted only where directed by the Owner’s Representative.
2. Provide remedial attention and repair to shrubs and trees as appropriate by season or in response to incidental damage.
3. Prune shrubbery to maintain proper size in relationship to adjacent planting and intended function.
4. Prune trees as required to remove weak branching patterns and maintain balance of head growth development. Remove lower limbs when obstructing vehicular or pedestrian clearances.
5. Prune groundcover plantings as required to restrain perimeter growth to within planting areas where adjacent to walks and curbs. Tip prune selected branchlets of low growing shrub or groundcover masses to maintain even overall heights and promote fullness.
6. Spent blooms shall be removed from all flowering shrubs to promote better growth habit and flower production.
7. Remove blades of ornamental grasses that lay over flat to the ground. Retain grasses that are able to support their own weight. In the early spring, tie-off ornamental

grasses with jute twine or a grass blade at the base of the plant and cut evenly across 6 inches from the base of the plant.

D. Raking: All planter beds will be raked through once per month to remove debris and promote an attractive fresh appearance.

E. Mulching: Maintain a **3**-inch depth of specified mulch over all shrub planting areas unless directed otherwise by the Owner's Representative. Do not mulch groundcover areas.

F. Tree Stakes:

1. Check ties every 4 months to ensure that they are not causing a depression in the bark. Loosen, repair or replace as required.
2. Retain guy wires in good repair until the tree is strong enough to withstand strong winds. Check at end of maintenance period. Ensure that they do not cause a depression in the bark. Repair or replace as required.

G. Cultivating:

1. In the spring, before beginning watering, cultivate the soil surface shallowly as necessary to ensure penetration of water and air into the soil. Repeat as necessary for weed control and soil permeability.
2. Avoid cultivating into the root zone of plants, particularly shallow-rooted groundcovers and rhododendrons.

3.4 NATIVE PLANTING AREAS

A. The level and style of maintenance shall reflect the native landscape character of these portions of the site.

B. Weed Control:

1. The Contractor shall remove only noxious weeds and non-native volunteer species. Inspect for weed growth once per month. Remove all weeds within two weeks of inspection.
2. Native species that naturalize in native planting areas shall not be removed. The growth of such plants shall be encouraged by maintenance procedures.
3. The type of weeds in an area shall determine the method of treatment. Weed control may consist of, but is not limited to, the following:

    a. Hand-pulling, digging, cultivation.
    b. Encouraging the growth of desired plants which can compete with weeds.
    c. Timing the mowing of grass areas to correspond with the seeding cycle of weeds.
    d. Use of approved contact herbicide, applied only by licensed applicator.

C. Fertilizing:

1. Fertilizing and Liming: Perform as recommended in the soil analysis reports and as necessary to maintain cover crop in a healthy growing condition. See Division 32 Section “Soil Preparation.”
2. Fertilizing of all trees, shrubs and ground cover is to be done once at the end of the maintenance period. Work the fertilizer thoroughly into the top 2 inches of soil.
3. In March, within the first growing season, fertilize all planting areas with 1 application of each of the following fertilizers, all at the rate of 7 pounds per 1000 square feet of soil surface:

    a. Nitroform slow release (38-0-0)
    b. Treble superphosphate (0-45-0)
    c. Sulphate of potash (0-0-50)

D. Pruning: Pruning shall be done to enhance natural growth. Remove dead, damaged and diseased portions of the plant. Do not remove collar at the branch base when pruning. All major pruning shall be done following flowering or during plant's dormant season. Emergency or minor pruning shall be done when needed. Pruning of trees shall be performed by a certified arborist.

1. Provide remedial attention and repair to shrubs and trees as appropriate by season or in response to incidental damage.
2. If at the time of installation, native plants are not proportioned as specified, pruning operations shall be done to encourage the growth of full, well-proportioned plants. Such pruning will likely include but not be limited to removal of long, “leggy” branches and shearing plants back to encourage the growth of more branches. The Contractor shall ask for direction from the Owner’s Representative before beginning this Work.

E. Seeded Areas:

1. The Contractor shall be responsible for protecting seeded areas from damage and maintaining seeded areas as necessary to establish a complete coverage of the specified vegetation in a healthy and growing condition for 365 days from the date of substantial completion of the project.
2. Mowing: Mow all seeded areas as required to maintain in a healthy growing condition, and to control the germination and spread of noxious weeds. Mow a minimum of once per maintenance period. Line trimmers may be used where appropriate.
3. Re-Seeding: Upon detection of damaged or failing areas and areas showing unsatisfactory growth and coverage, the Contractor shall restore the area as necessary to establish a complete cover crop. Reseed using the seed mixes specified.

F. Do not mulch native planting areas.

G. Rodent Control: The Contractor shall take the necessary action to prevent damage to all plants by rodents and moles. Such damage that does occur shall be repaired by the Contractor. The Contractor may install wire mesh or plastic guards around the base of plants.

3.5 IRRIGATION EQUIPMENT WARRANTY WORK AND OPERATION

A. Establish time settings and intervals of irrigation water application for each valve of all irrigation zones. Make changes when necessary to correspond to variable watering requirements for all planting areas.

B. Observe operation of all irrigation heads at least twice each operating month. Check for coverage and plugged or broken heads and leaks; repair leaks, balance system and clean or replace heads or nozzles as required to maintain system in proper working order. Replacement heads shall be as originally specified in the Drawings and Specifications.

C. Perform necessary site visits and observations to maintain the proper amounts of moisture in soils to promote healthy and vigorous plant growth. Correct conditions of over or under-watering as may be determined by weekly observations during the irrigation season.

D. System Winterization: Shut off and completely drain systems no later than November 1. Turn off all main supply valves; open all manual drain valves; air drain, and bleed valves on backflow prevention devices. Perform winterization prior to the specified dates in the event of earlier freezing weather.

E. System Spring Start-up: Activate irrigation systems in late March. Contractor shall be responsible for repairing damage caused by freezing at no additional cost to Owner. Operate and observe all portions of the system and perform necessary rebalancing, flushing, cleaning or other work required to re-establish proper irrigation functions.

1. Test and certify backflow preventers prior to placing the irrigation system back in service.

    a. Original copies of the certification shall be submitted to the Owner.
    b. Backflow preventers shall be labeled with plastic laminated field history tag showing date and tester information.

2. Flush drip valve filters and backflow preventer “Y”-strainers.

F. Repair and/or replacement for any work damaged or otherwise affected even by causes beyond Contractor's control shall be the responsibility of the Contractor.

G. Repair trench backfill which settles more than 1 inch during the Irrigation Warranty period. Warranty to include repair of planting areas, lawns, paving and walks damaged by settlement.

END OF SECTION 32 9500

SECTION 33 1100 - WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.2 SUBMITTALS

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

1. Valves and accessories
2. Water meters and accessories
3. Backflow preventers and assemblies.
4. Fire hydrants.
5. Fire department connections.
6. Pipe.
7. Pipe restraint

B. Field quality-control test reports.

C. Operation and maintenance data for the following:

1. Valves
2. Backflow preventers

D. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

F. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.4 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution 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 water-distribution service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Architect's written permission.

1.5 COORDINATION

A. Coordinate connection to water main with City of Albany.

PART 2 - PRODUCTS

2.1 GENERAL

A. All pipes and fittings delivered to the job site shall be clearly marked to identify the material, class, thickness, and manufacturer.

B. All material shall be new and free of blemishes.

C. Piping materials of like kind shall be the product of one manufacturer.

2.2 PIPE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L, water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

B. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L, water tube, drawn temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

C. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, Class 52 minimum, cement-mortar lined, asphaltic-coated, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, Class 52 minimum, cement-mortar lined, asphaltic-coated, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

E. PVC Schedule 40 Pipe: ASTM D 1785.
1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.

F. PVC Schedule 80 Pipe: ASTM D 1785.
1. PVC Schedule 80 Socket Fittings: ASTM D 2467.
2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.

2.3 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, BCuP Series.

B. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

C. Soldering Flux: ASTM B 813, water-flushable type.

D. Solder Filler Metal: ASTM B 32, lead-free type with .20 percent maximum lead content.

2.4 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

a. Standard: AWWA C219.

2.5 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

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. American AVK Co.; Valves & Fittings Div.
   b. American Cast Iron Pipe Co.; American Flow Control Div.
   c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
   d. Crane Co.; Crane Valve Group; Stockham Div.
   e. East Jordan Iron Works, Inc.
   f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
   g. McWane, Inc.; Kennedy Valve Div.
   h. McWane, Inc.; M & H Valve Company Div.
   i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
   j. Mueller Co.; Water Products Div.
   k. NIBCO INC.
   l. U.S. Pipe and Foundry Company.

2. Nonrising-Stem, Resilient-Seated Gate Valves:

   a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

      1) Standard: AWWA C509.
      2) Minimum Pressure Rating: 200 psig.
      3) End Connections: Mechanical joint.
      4) Interior Coating: Complying with AWWA C550.

3. Nonrising-Stem, Resilient Wedge Gate Valve:

   a. Description: ductile iron body bonnet and wedge. The wedge shall be encapsulated in rubber.

      1) Standard: AWWA C515.
      2) Minimum pressure rating: 200 psig.
      3) End Connections: Mechanical joint.
      4) Interior coating: Complying with AWWA C550.

4. OS&Y, Rising Stem, Reduced Wall, Resilient-Seated Gate Valves.

   a. Description: Ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

      1) Standard: AWWA C515.
      2) Minimum Pressure Rating: 200 psig.

3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

5. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig.
3) End Connections: Flanged.

B. UL/FMG, Cast-Iron Gate Valves:

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. American Cast Iron Pipe Co.; American Flow Control Div.
b. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
c. Crane Co.; Crane Valve Group; Stockham Div.
d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).McWane, Inc.; Kennedy Valve Div.
e. McWane, Inc.; M & H Valve Company Div.
f. Mueller Co.; Water Products Div.
g. NIBCO INC.
h. U.S. Pipe and Foundry Company.

2. UL/FMG, Nonrising-Stem Gate Valves:

a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psig.
3) End Connections: Flanged.

3. OS&Y, Rising-Stem Gate Valves:

a. Description: Iron body and bonnet and bronze seating material.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psig.
3) End Connections: Flanged.

C. Bronze Gate Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Div.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Red-White Valve Corporation.

2. OS&Y, Rising-Stem Gate Valves:

a. Description: Bronze body and bonnet and bronze stem.

1) Standards: UL 262 and FMG approved.
2) Minimum Pressure Rating: 175 psig.
3) End Connections: Threaded.

3. Nonrising-Stem Gate Valves:

a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.

1) Standard: MSS SP-80.

2.6 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

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. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
b. East Jordan Iron Works, Inc.
c. Flowserve.
d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
e. McWane, Inc.; Kennedy Valve Div.
f. McWane, Inc.; M & H Valve Company Div.
g. Mueller Co.; Water Products Div.
h. U.S. Pipe and Foundry Company.

2. Description: Sleeve and valve compatible with drilling machine.

a. Standard: MSS SP-60.
b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.7 WATER METERS

A. Water meters will be furnished & installed by the City of Albany

2.8 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

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. Ames Fire & Waterworks; a division of Watts Regulator Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Flomatic Corporation.
    e. Watts Water Technologies, Inc.
    f. Wilkins; a Zurn company.

2. Standard: AWWA C511.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size: Per Plan
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved, steel with interior lining complying with AWWA C550 or that is FDA approved, or stainless steel for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; Flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
    c. [Strainer]
    d. Above Ground Enclosure: Prefabricated fiberglass or aluminum enclosure meeting the following performance requirements:
        1) Freeze protection: Enclosure must provide at least 6.5R factor insulation. Attaching insulation to the back-flow assembly is not permitted.

2) Heater: Enclosure shall be equipped with an integral heater unit or wrap the back-flow assembly in heat trace tape.
3) Provide sufficient clearances to adequately access all parts of the selected back-flow assembly.
4) Provide access so that testing and maintenance activities can be completed without having to enter the enclosure.
5) Provide drain port(s) along the bottom of the enclosure.
6) Enclosure shall be bolted to a concrete pad per the manufacturer's recommendations. Pad shall extend a minimum of 4-inches beyond the edge of the enclosure.

B. Double-Check, Backflow-Prevention Assemblies:

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. Ames Fire & Waterworks; a division of Watts Regulator Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Watts Water Technologies, Inc.
   f. Wilkins; a Zurn company.

2. Standard: AWWA C510.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size: Per Plan
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved, steel with interior lining complying with AWWA C550 or that is FDA approved, or stainless steel for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.9 WATER METER BOXES

A. Water meter boxes will be furnished installed by the City of Albany

2.10 CONCRETE VAULTS

A. Description: Precast, reinforced-concrete vault, designed for H-20 load designation according to ASTM C 857 and made according to ASTM C 858.

1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
2. Hatch: Diamond plate aluminum or galvanized steel lift-assist door. See plans for model number and/or size.

3. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

4. Riser extensions: Provide riser extensions matching vault size as necessary to match proposed grades.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 3 shall be:

1. Soft copper tube, ASTM B 88, Type K, or ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
2. PVC, Schedule 40 or Schedule 80 socket fitting; and solvent-cemented joints.

F. Underground water-service piping NPS 4 and NPS 12 shall be the following:

1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

G. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 shall be same as underground water-service piping.

H. Aboveground and Vault Water-Service Piping NPS 3/4 to NPS 3 shall be hard copper tube, ASTM B 88, Type K or ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

I. Aboveground and vault water-service piping NPS 4 and NPS 6 shall be any of the following:

1. Hard copper tube, ASTM B 88, Type K or ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

2. Ductile-iron, flanged-end pipe; ductile-iron, flanged-end appurtenances; and flanged joints.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
3. Use the following for valves in vaults and aboveground:

   a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.
   b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

D. Install PE pipe according to ASTM D 2774 and ASTM F 645.

E. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

F. Bury piping with depth of cover over top at least 36 inches, with top at least 12 inches below level of maximum frost penetration.

G. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at within 5 feet of building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, mechanical restraints, and other supports.

3.5 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
4. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
5. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.6 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

C. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.8 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick, concrete piers, or pipe supports.

3.9 CONCRETE VAULT INSTALLATION

A. Install precast concrete vaults according to ASTM C 891 and manufacturer's recommendations.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water-distribution piping to utility water main.

3.11 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.12 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 33 1100

SECTION 33 4020 – DECORATIVE DRAIN FRAMES AND GRATES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Decorative drains and grates in pavement.

B. Related Sections include the following:

1. Division 31 Section “Earth Moving” for trenching and backfill of piped utilities.
2. Division 33 Section “Storm Drainage Utilities” for catchment and piping of storm water.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Trench drain frames and grates

PART 2 - PRODUCTS

2.1 DRAINS

A. Ductile-Iron Trench Drains and Frames:

1. ASTM A 536-84-grade 65-45-12 ASME A112.21.1M, , frame with anchor flange or other anchoring device, and secured grate. Include units of total length indicated and number of bottom outlets with inside calk or spigot connections, of sizes indicated.

a. Manufacturer: Iron Age Designs, ph 877-418-3568 (www.ironagegrates.com)
b. Model: Regular Joe Heel Proof Bolt-Down Radius Grate with frame.
c. Finish: Oil finish iron
d. Size: 5.38 inches wide by 19.94 inches (500mm) long.

B. Cast-Iron Trench Drains cast with Cast Concrete Channels:

1. ASTM A 48, Class 35b or better drain grate with angle iron supports custome formed into curves. Include units of total length and sizes indicated.

a. Manufacturer: Iron Age Designs, ph 877-418-3568 (www.ironagegrates.com)
b. Model: Regular Joe Heel Proof Bolt-Down Radius Grate with frame.

c. Finish: Oil finish iron
d. Size: 5.38 inches wide by 19.94 inches (500mm) long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where drains are to be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected to the approval of the Owner's Representative.

3.2 DRAINAGE SYSTEM INSTALLATION

A. Assemble and install components according to manufacturer's written instructions.

B. Install with top surfaces of drains flush with adjacent pavement surface.

C. Embed frame sections in concrete per drawings with 4-inchminimum concrete around bottom and sides.

D. Fasten grates to channel sections with tamper-proof fastener.

E. Provide channel accessories as supplied by drainage system manufacturer to provide and complete and closed system.

3.3 CLEANING

A. Clear interior of trenches to remove dirt and other superfluous material as work progresses.

B. Protect grates and frames from damage until Final Acceptance.

END OF SECTION 33 4020

SECTION 33 4100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes gravity-flow nonpressure storm drainage outside the building, with the following components:

1. Pipe and fittings.
2. Trench Drains.
3. Manholes.
4. Cleanouts.
5. Nonpressure transition couplings.
6. Catch basins.
7. Stormwater inlets.
8. Pipe outlets.

1.2 SUBMITTALS

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

1. Backwater valves.
2. Cleanouts.
3. Inlets.
4. Pipe.
5. Fittings.
6. Drains.
7. Trench Drains.

B. Shop Drawings:

1. Precast Concrete Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
3. Cast-in-place concrete manholes, including frames and covers.
4. Pre-cast concrete structures, including frames and covers.

C. 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 Architect no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Architect's written permission.

B. Site Information: Research public utility records, and verify existing utility locations prior to ordering any materials. Notify Architect immediately if any discrepancies are found in the project Survey.

PART 2 - PRODUCTS

2.1 Refer to Part 3 “Piping Applications” for applications of pipe, fitting, and joining materials.

2.2 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: ASTM A 746, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.3 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252M, Type S, with smooth waterway for coupling joints.

1. Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.

B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

2.4 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35 with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-1 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.5 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and 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.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: Cleanouts: At grade cleanouts shall have an adjustable sleeve-type housing, a threaded brass plug with counter sunk slot, and cast iron frame and cover.
2. Top-Loading Classification(s): Light Duty, Medium Duty, Heavy Duty, and, Extra-Heavy Duty.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.7 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation, if site conditions warrant and/or as shown in the plans.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 23-inch ID by 6- to 10-inch riser with 3.5-inch- minimum width flange and 25-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48/A 48M, Class 30 gray iron unless otherwise indicated.

2.8 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 3000 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: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

   a. Slope: 4 percent.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.9 POLYMER-CONCRETE TRENCH DRAINS

A. General Requirements for Polymer-Concrete, Channel Drainage Systems: Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include quantity of units required to form total lengths indicated.

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

1. ACO USA.
2. Poly-Cast.
3. Zurn.
4. Approved equal.

C. Polymer-Concrete Systems:

1. Channel Sections:

a. Interlocking-joint, precast, modular units with end caps.
b. 4-inch inside width and deep, rounded bottom, and with outlets in quantities, sizes, and locations indicated.
c. Extension sections necessary for required depth.
d. Frame: Include ductile iron or steel frame for grate.

2. Grates:

a. Manufacturer's designation "Medium Duty," with slots or perforations that fit recesses in channels.
b. Material: Ductile iron

3. Covers: Solid gray iron if indicated.
4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
5. Invert: Per Plan.

D. Drainage Specialties: Precast, polymer-concrete units.

1. In-line Catch Basins:

a. 24-inch deep polymer-concrete body, with outlets in quantities and sizes indicated.
b. ADA iron, slotted iron or perforated steel.
c. Grate load class: C.

E. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.

F. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.10 CATCH BASINS

A. Trapped Catch Basins: 10-Gauge steel plate bituminous coated as manufactured by Lynch, Gratemaster, Gibson Steel Basins, or approved equivalent. Reinforced concrete collars shall be installed per the Drawings.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for heavy-duty service H-20, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 28 by 28 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

C. Nyloplast Catch Basins:

1. Description: Round catch basin structure as indicated on the Contract Drawings.
2. Material: Structure shall be made out of PVC meeting ASTM D 1784. Joint tightness shall conform to ASTM D 3212. Flexible elastomeric seals shall conform to ASTM F 477.
3. Grates: Grates and frames shall be ductile iron and made specifically for each basin so as to provide a round bottom flange that closely matches the diameter of the catch basin. Grates shall be capable of supporting H-20 wheel loading for traffic areas or hold loading for pedestrian areas. Metal shall conform to ASTM A 536 grade 70-50-05 for ductile iron and be painted black.
4. Reinforced concrete collar shall be installed per the drawings.

PART 3 - EXECUTION

3.1 EARTHWORK

1. Excavation, trenching, and backfilling are specified in Section 31 20 00 "Earth Moving." Install tracer wire directly over piping and at outside edges of underground structures. See section 31 20 00 “Earth Moving” for tracer wire material requirements.

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 or microtunneling.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow at a minimum slope of 1 percent, unless otherwise indicated.
2. Install piping with 36-inch minimum cover, unless otherwise indicated.
3. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
4. Install PE corrugated sewer piping according to ASTM D 2321.
5. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
6. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
8. Install piping below frost line.
9. Install hub-and-spigot cast iron piping according to CISPI's "Cast Iron Soil Pipe and Fittings" handbook.
10. Install hubless cast iron piping according to CISPI 301 and CISPI's "Cast Iron Soil Pipe and Fittings" handbook.

G. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:

1. Ductile-iron pipe and fittings.

H. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
2. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
3. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
4. Join PVC corrugated sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints.
5. Join nonreinforced-concrete sewer piping according to ASTM C 14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
6. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
7. Join dissimilar pipe materials with nonpressure-type flexible couplings.
8. Join hub-and-spigot cast iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings" handbook for compression joints.
9. Join hubless cast iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings" handbook for hubless-coupling joints.

B. Pipe couplings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Unshielded flexible couplings for pipes of same or slightly different OD.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use PVC fittings in sewer pipes at branches for cleanouts and PVC pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, as indicated on plans. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

A. Set frames and grates to elevations indicated.

3.7 NYLOPLAST CATCH BASIN INSTALLATION

A. Set frames and grates to elevations indicated per the manufacturer's recommendations.

3.8 STORMWATER OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap as indicated.

3.9 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.10 CONNECTIONS

A. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

B. Pipe couplings and expansion joints with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Unshielded flexible couplings for same or minor difference OD pipes.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.11 IDENTIFICATION

A. Install green tracer wire directly over piping and at outside edges of underground structure. See Section 31 20 00 “Earth Moving” for tracer wire material requirements.

3.12 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. Option: Test plastic piping according to ASTM F 1417.
    b. Option: Test concrete piping according to ASTM C 924.

6. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.

a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

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 33 4100