COBB COUNTY-MARIETTA WATER AUTHORITY

JAMES E. QUARLES WTP

RESERVOIR CLEANING AND

IMPROVEMENTS PROJECT

CCMWA Project No. 505-9005-38-20-0000

Permitting Submittal

CONTRACT REQUIREMENTS AND SPECIFICATIONS

VOLUME 2 OF 2

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COBB COUNTY-MARIETTA WATER AUTHORITY

JAMES E. QUARLES WTP RESERVOIR CLEANING AND IMPROVEMENTS PROJECT

CCMWA Project No. 505-9005-38-20-0000

SEPTEMBER 2024 PERMITTING DOCUMENTS

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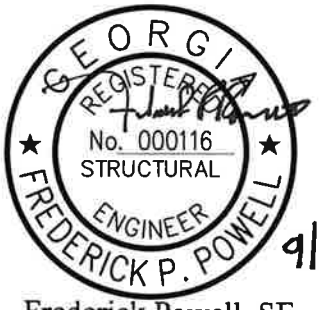

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JAMES E. QUARLES WTP

RESERVOIR CLEANING AND IMPROVEMENTS PROJECT

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SECTION 02 41 16

DEMOLITION AND REMOVAL OF EXISTING STRUCTURES AND EQUIPMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. This Section covers the demolition, removal, and disposal of existing structures and any existing equipment including gates and hardware as indicated on Drawings and as specified, as well as, electrical, plumbing, and piping not required for the operation of the facility and as indicated on the Drawings and as specified hereinafter. The Contractor shall furnish all labor, materials, and equipment to demolish structures and to remove fixtures, anchors, supports, piping, and accessories designated to be removed on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 14 00 - Coordination with Owner's Operations

B. Section 01 42 00 - References

1.03 TITLE TO EQUIPMENT AND MATERIALS

A. Contractor shall have no right or title to any of the equipment, materials, or other items to be removed from the existing structures unless and until said equipment, materials and other items have been removed from the premises. The Contractor shall not sell or assign or attempt to sell or assign any interest in the said equipment, materials, or other items until the said equipment, materials or other items have been removed.

B. Contractor shall have no claim against the Owner because of the absence of such fixtures and materials.

1.04 CONDITION OF STRUCTURES AND EQUIPMENT

A. The Owner does not assume responsibility for the actual condition of structures and equipment to be demolished and removed.

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

C. The information regarding the existing structures and equipment shown on the Drawings is based on visual inspection and a walk-through survey only. Neither the Engineer nor the Owner will be responsible for interpretations or conclusions drawn therefrom by the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 DEMOLITION AND REMOVALS

A. The removal of all equipment and piping, and all materials from the demolition of structures shall, when released by the Owner and Engineer, be done by the Contractor, and shall become the Contractor's property, unless otherwise noted, for disposition in any manner not contrary to the Contract requirements and shall be removed from the site to the Contractor's own place of disposal.

B. The Electrical Contractor (Subcontractor) specifically, shall de-energize all panelboards, lighting fixtures, switches, circuit breakers, electrical conduits, motors, limit switches, pressure switches, instrumentation such as flow, level and/or other meters, wiring, and similar power equipment prior to removal. Any electric panels or equipment which are to be retained shall be relocated or isolated by the Electrical Contractor (Subcontractor) specifically, prior to the removal of the equipment specified herein.

C. The Contractor shall proceed with the removal of the equipment, piping and appurtenances in a sequence designed to maintain the plant in continuous operation as described in Section 01 14 00 - Coordination with Owner’s Operations and shall proceed only after approval of the Engineer.

D. Any equipment piping and appurtenances removed without proper authorization, which are necessary for the operation of the existing facilities shall be replaced to the satisfaction of the Engineer at no cost to the Owner.

E. Excavation caused by demolition shall be backfilled with fill free from rubbish and debris. Select fill or structural fill shall be used where specifically required on Contract Drawings.

F. Burning of any debris resulting from the demolition will not be permitted at the site.

G. Where parts of existing structures are to remain in service, demolish the portions to be removed, repair damage, and leave the structure in proper condition for the intended use. Remove concrete and masonry to the lines designated by drilling, chipping, or other suitable methods. Leave the resulting surfaces reasonably true and even, with sharp straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended. Where existing reinforcing bars are to extend into new construction, remove the concrete so that the reinforcing is clean and undamaged. Cut off other reinforcing 1/2-inch below the surface and fill with epoxy resin binder flush with the surface.

H. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of the adjoining and/or nearby structures. Photographs and records

shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

3.02 PROTECTION

A. Demolition and removal work shall be performed by competent experienced workmen for the various type of demolition and removal work and shall be carried out through to completion with due regard to the safety of Owner employees, workmen on-site and the public. The work shall be performed with as little nuisance as possible.

B. The work shall comply with the applicable provisions and recommendation of OSHA all governing codes, and as hereinafter specified.

C. The Contractor shall make such investigations, explorations, and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. The Contractor shall give particular attention to shoring and bracing requirements to prevent any damage to new or existing construction.

D. The Contractor shall provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, workmen engaged in demolition operations, and adjacent construction.

E. The Contractor shall provide and maintain weather protection at exterior openings to fully protect the interior premises against damage from the elements until such openings are closed by new construction.

F. The Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and new work is being done, connections made, materials handled, or equipment moved.

G. The Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster, and similar debris. Unaltered portions of the existing structures affected by the operations under this Section shall be protected by dust-proof partitions and other adequate means.

H. The Contractor shall provide adequate fire protection in accordance with local Fire Department requirements.

I. The Contractor shall not close or obstruct walkways, passageways, or stairways and shall not store or place materials in passageways, stairs, or other means of egress. The Contractor shall conduct operations with minimum traffic interference.

J. The Contractor shall be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.

3.03 WORKMANSHIP

A. The demolition and removal work shall be performed as described in the Contract Documents. The work required shall be done with care, and shall include all required shoring, bracing, etc. The Contractor shall be responsible for any damage which may be caused by demolition and removal work to any part or parts of existing structures or items designated for reuse or to remain. The Contractor shall perform patching, restoration, and new work in accordance with applicable Technical Sections of the Specifications and in accordance with the details shown on the Drawings. Prior to starting of work, the Contractor shall provide a detailed description of methods and equipment to be used for each operation and the sequence thereof for review by the Engineer.

B. All supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise specified or required. Concrete bases, anchor bolts and other supports shall be removed to approximately 1-inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas. Damaged surfaces shall be patched to match the adjacent areas, as specified under applicable Sections of these Specifications, as shown on the Drawings, or as directed by the Engineer. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate Sections of these Specifications, as shown on the Drawings, and as directed and approved by the Engineer.

C. Materials or items designated to remain the property of the Owner shall be as hereinafter tabulated. Such items shall be removed with care and stored at a location at the site to be designated by the Owner.

D. Where equipment is shown or specified to be removed and relocated, the Contractor shall not proceed with removal of this equipment without specific prior approval of the Engineer. Upon approval, and prior to commencing removal operations, the equipment shall be operated in the presence of representatives of the Contractor, Owner and Engineer. Such items shall be removed with care, under the supervision of the trade responsible for reinstallation and protected and stored until required. Material or items damaged during removal shall be replaced with similar new material or item. Any equipment that is removed without proper authorization and is required for plant operation shall be replaced at no cost to the Owner.

E. Wherever piping is to be removed for disposition, the piping shall be drained by the Contractor and adjacent pipe and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.

F. Materials or items demolished and not designated to become the property of the Owner or to be reinstalled shall become the property of the Contractor and shall be removed from the property and legally disposed of.

G. The Contractor shall execute the work in a careful and orderly manner, with the least possible disturbance to the operation of the facility and to the surrounding public..

H. In general, concrete structures shall be demolished in small sections, and where necessary to prevent collapse of any construction, the Contractor shall install temporary shores, struts, and bracing.

I. Where alterations occur, or new and old work join, the Contractor shall cut, remove, patch, repair or refinish the adjacent surfaces to the extent required by the construction conditions, to leave the altered work in as good a condition as existed prior to the start of the work. The materials and workmanship employed in the alterations, unless otherwise shown on the Drawing or specified, shall comply with that of the various respective trades which normally perform the items of work.

J. The Contractor shall finish adjacent existing surfaces to new work to match the specified finish for new work. The Contractor shall clean existing surfaces of dirt, grease, loose paint, etc., before refinishing.

K. The Contractor shall cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.

L. The Contractor shall remove temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the work.

3.04 MAINTENANCE

A. The Contractor shall maintain the structures, and public properties free from accumulations of waste, debris, and rubbish, caused by the demolition and removal operations.

B. The Contractor shall provide on-site dump containers for collection of waste materials, debris, and rubbish, and shall wet down dry materials to lay down and prevent blowing dust.

C. At reasonable intervals during the progress of the demolition and removal work or as directed by the Engineer, the Contractor shall clean the site and properties, and dispose of waste materials, debris, and rubbish.

3.05 EQUIPMENT AND MATERIALS RETAINED BY OWNER

A. All debris resulting from the demolition and removal work shall be disposed of by the Contractor as part of the work of this Contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of off-site by the Contractor at his expense.

END OF SECTION

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SECTION 03 01 30
CONCRETE REPAIRS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all materials, labor, equipment, tools, etc., required for the repair, renovation, and replacement of concrete and/or reinforcing steel as indicated on the Drawings, specified herein, and determined by field survey.

B. The Contractor, in conjunction with the Engineer, shall determine the extent of cracked or deteriorated concrete to be rehabilitated and/or resurfaced. A summary of the work to be performed shall be submitted to the Engineer for review, and such summary shall be approved by the Engineer prior to commencement of the Work.

C. Concrete repairs include the following:

1. Repair of spalled, deteriorated, and cracked concrete in the reservoir Splitter Box and Structures A thru E.

2. Removal of unsound materials, surface preparation, and resurfacing of the interior and exterior concrete walls for Structures A thru E and Splitter Box structure. All walls are to be repaired full height.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01 – General Requirements

B. Section 01 20 00 – Measurement and Payment

C. Division 03 – Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Shall be as specified in Section 01 42 00 – References.

B. ICRI CSP – International Concrete Repair Institute Concrete Surface Profile.

1.04 SUBCONTRACTOR/APPLICATOR QUALIFICATIONS

A. The Contractor shall furnish the name of all subcontractors/applicators which he proposes to use for this work, including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, urethane, and polymer-modified repair materials.

B. Approved applicator qualifications shall include a minimum of 5 years of experience in applying epoxy, urethane, and polymer-modified and cement-based repair materials like those materials specified in this Section.

C. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for applying the product, including surface preparation and mixing, placing, curing, and caring for the manufacturer's products shall be submitted. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

1.05 SUBMITTALS

A. Material certifications and technical data sheets on all grouts, mortars, epoxy resins, aggregates and repair products specified in this Section.

B. Subcontractor/Applicator qualifications as specified in Section 1.04.

C. Shop Drawings detailing any planned deviation from the proposed construction sequence and/or method of repair.

D. The Contractor, based on their experience in their profession, and/or recommendation from product manufacturers, may submit to the Engineer for approval, alternative materials and/or methods of work to assure the durability and watertight integrity of the repair work performed.

E. Detailed repair procedures for each repair type.

F. Letter from repair material manufacturer(s) certifying that all repair materials to be used to create single repairs are compatible for use together.

1.06 ADDITIONAL GUARANTEE

A. The Contractor shall guarantee all repair work performed under this Contract against defects in workmanship resulting in leakage and/or failure of concrete bond for a period of three (3) years from the date of the Certificate of Substantial Completion.

PART 2 – MATERIALS

2.01 GENERAL

A. All concrete repair materials shall conform to NSF Standards for contact with potable water supplies.

B. All concrete repair materials, when used in combination to create a single repair, shall be compatible.

2.02 WATER

A. The water used for mixing concrete repair products shall be clear, potable, and free of deleterious substances.

2.03 AGGREGATE

A. All aggregate shall conform to ASTM C-33. The aggregate supplier shall submit to the Engineer documentation that the proposed aggregates comply with ASTM C-33 and the requirements listed below:

B. Pea Gravel - Pea gravel shall meet the gradation and material requirements of Standard Size 14 as defined by ASTM C-33. Pea gravel shall be clean and free from deleterious matter and shall contain no limestone.

2.04 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C-881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures. The epoxy resin shall be "Sikadur Hi-Mod Series" as manufactured by the Sika Corp, Lyndhurst, NJ, "Duralbond" as manufactured by Euclid Chemical Company, Cleveland, OH, "Euco #452 Series" by the Euclid Chemical Company, or "MasterEmaco ADH series" by Master Builders Solutions.

2.05 ANTI-CORROSION REBAR COATING

A. Anti-corrosive coating shall be a two-component, polymer-modified cementitious material such as "Sika Armatec 110 EpoCem " manufactured by Sika Corp., Lyndhurst, NJ, Atlanta, GA, "Duralprep A.C." by the Euclid Chemical Company, or "MasterEmaco P 124" by Master Builders Solutions.

2.06 TYPE I CRACK REPAIR - CEMENTITIOUS SURFACE SEAL

A. Type I Crack Repair - Cementitious Surface Seal shall be a one- or two-component, polymer-modified or silica fume enhanced trowel grade cementitious mortar and shall conform to EPA/USPHS standards for surface contact with potable water supplies. Type I Crack Repair material shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "Verticoat" or "Verticoat Supreme" by Euclid Chemical Company; or "Emaco S88 CI" or by Master Builders Solutions.

2.07 TYPE II CRACK REPAIR – EPOXY INJECTION CRACK REPAIR

A. Type II Crack Repair – Epoxy Injection Crack Repair shall be a two-component, 100% solids, high-modulus, low viscosity, moisture insensitive epoxy adhesive designed for

structural repair. The epoxy adhesive shall be "Sikadur 52" manufactured by Sika Corp., Lyndhurst, NJ, "Duralcrete LV" manufactured by Euclid Chemical Company, Cleveland, OH, “Eucopoxy Injection Resin” by the Euclid Chemical Company, or “MasterInject 1500” by Master Builders Solutions.

2.08 TYPE III CRACK REPAIR - WATERPROOF INJECTION GROUT

A. Type III Crack Repair - Waterproof Injection Grout shall be a one-component, water-activated, extra-low viscosity polyurethane or methacrylic acrylate hydrophilic injection grout capable of 400% expansion. Injection grout shall form a tough flexible foam seal that is impenetrable to water. Hydrophilic injection grout shall be “MasterInject 1210” manufactured by Master Builders Solutions, "Prime Flex 900 XLV" manufactured by Prime Resins, Conyers, GA, "AV-333 Injectaflex" manufactured by Avanti International, Webster, TX, or "DeNeef Sealfoam PURe" or “Gelacryl Superflex” manufactured by Grace Construction Products/GCP Applied Technologies or “SikaFix HH Hydrophilic” manufactured by Sika Corp., Lyndhurst, NJ.

2.09 SPALL REPAIR PATCHING MATERIAL

A. All spall repairs not requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar for use in horizontal applications shall be "Sikatop 122 Plus" manufactured by Sika Corp., Lyndhurst, NJ, “Eucocrete Supreme” or “Duraltop Flowable Mortar” by the Euclid Chemical Company, or “MasterEmaco T-302” or “MasterEmaco T310CI” by Master Builders Solutions. Spall repair mortar for use in vertical and overhead applications shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, “Verticoat or Verticoat Supreme” by the Euclid Chemical Company, or “MasterEmaco N 425” or “MasterEmaco N 400” by Master Builders Solutions.

B. All spall repairs requiring formwork shall be repaired using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar shall be "SikaTop 111 PLUS" manufactured by Sika Corp., Lyndhurst, NJ, "Eucocrete Supreme” manufactured by Euclid Chemical Company, Cleveland, OH, or “MasterEmaco T 310 CI” by Master Builders Solutions.

C. All spall repair materials shall conform to EPA/USPHS standards for surface contact with potable water supplies.

2.10 CEMENT BASED TEXTURED COATING

A. Cement based textured coating shall be "SikaTop 144" manufactured by Sika Corp., Lyndhurst, NJ, “MasterSeal 581” manufactured by Master Builders Solutions, "Duraltop Coating" manufactured by Euclid Chemical Company, Cleveland, OH, “Eucoseal or Tamoseal” by the Euclid Chemical Company. Cement based textured coating shall have a minimum durability of 10 years and be able to seal cracks with a width up to 1/8 inch.

2.11 CONCRETE WALL RESURFACING MATERIAL

A. Concrete wall resurfacing material shall be a one component, cementitious, low shrinkage, high strength, mortar. The resurfacing material shall be "SikaRepair 224" manufactured by Sika Corp, MasterEmaco S 488CI by BASF Master Builder Solutions, or MegaMix II by Xypex Chemical Corporation. The product shall be formulated for trowel or low-pressure applications. It shall be capable to be applied with a minimum thickness of 1/2 inch and maximum thickness of 2 inches.

2.12 OTHER MATERIALS

A. OAKUM ROPE – Oakum rope shall be dry type oakum or jute intended for use with polyurethane grouts for sealing cracks and gaps in concrete and shall be “DeNeef Dry Oakum” as manufactured by Grace Construction Products/GCP Technologies, or approved equal.

2.13 STORAGE OF MATERIALS

A. The Contractor shall provide an area for repair material storage free from exposure to moisture in any form, before, during, and after delivery to the site. Manufactured materials shall be delivered in unbroken containers labeled with the manufacturer's name and product type. All mortar products shall be stored on raised platforms. Materials susceptible to damage by freezing shall be stored in a dry, heated, insulated area. Any material that has hardened, partially set, become caked and/or has been contaminated or deteriorated shall be rejected. All aggregates shall be stored in clean bins, scows or platforms.

PART 3 – INSTALLATION

3.01 GENERAL REQUIREMENTS

A. No repair work shall be undertaken when ambient temperatures are below manufacturer's safe recommendations. No admixtures, except those required by the manufacturer, shall be used in the repairs specified herein.

B. All products shall be applied in strict accordance with manufacturer's recommendations. The Contractor shall furnish and install safe scaffolding and ladders for the Engineer's prework inspection, the repair work activities, and the Engineer's final inspection.

C. Sandblast or waterblast (3000-5000 psi waterjet) or use low impact hand chipping tools to clean deteriorated areas to remove all loose concrete, existing coatings, unsound material, debris, and laitance. All surfaces shall be clean, free of dirt, grease, loose particles, and deleterious substances and shall be prepared according to manufacturer's requirements.

3.02 EPOXY BONDING AGENT

A. An epoxy bonding agent shall be used when applying fresh concrete to previously placed concrete unless otherwise recommended by the manufacturer.

B. Existing concrete surfaces shall be roughened (1/16” or CSP 5 minimum profile) unless otherwise recommended by the manufacturer prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Repair material shall be placed while bonding agent is still tacky. If bonding agent cures prior to placement of repair material, bonding agent shall be reapplied.

C. Repairing concrete with epoxy mortars shall conform to all the requirements of ACI 503.4 "Standard Specification for Repairing Concrete with Epoxy Mortars" (latest edition), except as modified herein.

3.03 ANTI-CORROSION REBAR COATING

A. Reinforcing steel cut or exposed during demolition and/or repair operations shall be sandblasted and cleaned prior to coating with an anti-corrosive coating. Anti-corrosive coating shall be applied as soon as the reinforcement is exposed and cleaned. Coating shall thoroughly cover all exposed parts of the steel and shall be applied according to manufacturer's recommendations.

3.04 TYPE I CRACK REPAIR – CEMENTITIOUS SURFACE SEAL

A. As directed by the Engineer based on pre-construction inspection results, existing nonstructural cracks 1/16" and wider in vertical and overhead surfaces or existing cracks between 1/16" and 1/4" wide in horizontal surfaces shall be repaired with Type I Crack Repair Material. Rout crack to 3/4" wide by 3/4" deep V-notch to expose sound concrete. Provide a 3/8” high vertical shoulder at the top of notch on each side. Where rebar has deteriorated, or where deteriorated concrete extends below the top of rebar, crack shall be routed to expose 3/4" all around rebar. The resulting void in concrete shall be patched flush with the existing concrete surface using Type I Crack Repair material.

3.05 TYPE II CRACK REPAIR – EPOXY INJECTION

A. Vertical and Overhead Surfaces

1. As directed by the Engineer based on pre-construction inspection results, existing structural cracks 1/4" wide or narrower shall be repaired by pressure injecting Type II Crack Repair material into the prepared crack. Seal crack surface using epoxy resin binder and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has fully cured, inject crack with Type

II Crack Repair material using standard pressure injection equipment as directed by the manufacturer.

B. Horizontal Surfaces

1. As directed by the Engineer based on pre-construction inspection results, existing structural cracks 1/4" wide or narrower shall be repaired using Type II Crack Repair by pressure injecting Type II Crack Repair material into the prepared crack. Seal crack surface using epoxy resin binder and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has fully cured, inject crack with Type II Crack Repair material using standard pressure injection equipment as directed by the manufacturer.

2. As directed by the Engineer based on pre-construction inspection results, existing structural cracks wider than 1/4" shall be repaired by gravity feeding Type II Crack Repair material into the prepared crack. First rout the concrete surface to form a 1/4" wide by 1/4" deep v-notch and clean the crack to remove all loose and foreign particles. Fill the crack with clean, dry sand and then pour structural crack repair binder into V-notch, completely filling crack. As binder penetrates crack, additional binder shall be applied to the V-notch.

3.06 TYPE III CRACK REPAIR – WATERPROOF INJECTION GROUT

A. Existing, leaking cracks 1/4" or smaller, identified as nonstructural by the Engineer, shall be repaired by pressure injecting a Type III Crack Repair material into the prepared crack. Seal crack surface with epoxy binder and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has cured, clean, potable water shall be injected into the ports to flush the crack and provide the water necessary for chemical reaction of the grout. Immediately following injection of water, inject the crack with Type III Crack Repair material using standard pressure injection equipment as directed by the manufacturer.

B. All existing, leaking cracks larger than 1/4", not identified as structural by the Engineer, shall be repaired by first soaking oakum rope or open cell backer rod in waterproof injection grout, and then tightly packing the soaked oakum into the crack so as to completely fill the crack.

3.07 SPALL REPAIR PATCHING MATERIAL

A. All voids or spalled areas to be repaired shall be chipped back to sound concrete a minimum 1/8" deep, with a minimum surface profile of CSP-5, cleaned and repaired with

spall repair patching material according to manufacturer's recommendations. All patching shall provide a final finished surface which is flat, level and even with the existing concrete surface. Repair mortar shall not be feathered to meet existing concrete surface. Prior to commencing repair surface preparation, saw cut or grind a 1/2" deep groove around the perimeter around the repair area, perpendicular to the finished concrete surface to provide a square shoulder to the repair area. Repair areas shall be formed using clean, straight rectangular edges where possible. Final patching on horizontal surfaces shall receive a broom finish consistent with the finish on the existing structure.

3.08 EXPANSION JOINT REPAIR SYSTEM

A. Thoroughly clean the concrete substrate and apply Expansion Joint Repair System according to the manufacturer's recommendations.

3.09 WATERSTOP REPAIR SYSTEM

A. Remove all existing expansion joint sealant, backer rod, and expansion joint filler material as required to install the waterstop repair system.

B. Prepare existing concrete surfaces as required by the manufacturer.

C. Apply bonding agent to existing concrete and foam sealing strip or neoprene profile, and insert into expansion joint, as required by the manufacturer.

3.10 CEMENT BASED TEXTURED COATING

A. Thoroughly clean the concrete substrate and apply cement based textured coating according to manufacturer's recommendations. All necessary concrete repairs as detailed on the Contract Drawings shall be completed prior to applying coating.

3.11 CONCRETE WALL RESURFACING MATERIAL

A. Thoroughly prepare and clean the concrete substrate and apply concrete wall resurfacing material according to manufacturer’s recommendations.

B. Surfaces shall be thoroughly cleaned and sound by removing all loose, delaminated, and unsound concrete by high pressure water blast, chipping, mechanical scarification, or other appropriate mechanical means. Minimum surface profile shall be ICRI CSP-6. Pressure wash surface to remove laitance, micro fractured particles, and foreign matter. Repair existing steel reinforcement and apply anti-corrosion rebar coating. Concrete substrate is to be maintained as saturated, surface dry (SSD) condition during the application process. Apply a scrub coating on to the surface prior to applying full coat of mortar in accordance with the manufacturer. Concrete surfaces shall receive a smooth rubbed finish. Repair material shall be moist cured and protected for a minimum of three days.

C. Concrete wall resurfacing material shall be applied with a uniform thickness of 1/2 inch. Areas with surface defects and spalls shall be filled as necessary to maintain a uniform appearance.

D. Concrete wall resurfacing material shall have a smooth trowel finish on surfaces to be submerged and a uniform granular finish on exterior surfaces of the Splitter Box. The material shall be moisture cured per the manufacture's recommendations.

E. Prior to applying resurfacing material, the prepared existing concrete substrate shall be tested for surface adhesion. Surface adhesion of the prepared existing concrete substrate shall be tested in accordance with ASTM C1583 at a minimum of three random locations at each structure and as required by the manufacturer. Each test shall consist of a minimum of three 50mm dollies which are adhered to the wall. The near-surface tensile strength of the substrate shall exceed 300 psi and meet the resurfacing material manufacturer's requirements for adhesion of the material to the prepared surface. If pull tests average less than the required strength, then the substrate shall be re-grit blasted, removing at least 1/8" of concrete thickness and retested until it meets the specified near-surface tensile strength.

3.12 CURING

A. All repair products shall be cured in strict accordance with manufacturer recommendations. Wet curing is preferred where possible.

3.13 WORK IN CONFINED SPACES

A. The Contractor shall provide and maintain safe working conditions for all employees and subcontractors. Fresh air shall be supplied continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or by direct air supply to individual workers. Fumes shall be exhausted to the outside from the lowest level of the confined space. Electrical fan motors shall be explosion-proof if in contact with fumes. No smoking or open fires shall be permitted in or near areas where volatile fumes may accumulate.

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SECTION 03 11 00
CONCRETE FORMWORK

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Provide materials, labor, and equipment required for the design and construction of all concrete formwork, bracing, shoring and supports in accordance with the provisions of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 21 00 – Reinforcing Steel

B. Section 03 15 00 – Concrete Accessories

C. Section 03 15 16 – Joints in Concrete

D. Section 03 30 00 – Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Georgia Building Code

2. ACI 318 – Building Code Requirements for Structural Concrete

3. ACI 301 – Specifications for Structural Concrete for Buildings

4. ACI 347 – Recommended Practice for Concrete Formwork

5. U.S. Product Standard for Concrete Forms, Class I, PS 1

6. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Manufacturer's data on proposed form release agent

2. Manufacturer's data on proposed formwork system including form ties

1.05 QUALITY ASSURANCE

A. Concrete formwork shall be in accordance with ACI 301, ACI 318, and ACI 347.

PART 2 – PRODUCTS

2.01 FORMS AND FALSEWORK

A. All forms shall be smooth surface forms unless otherwise specified.

B. Wood materials for concrete forms and falsework shall conform to the following requirements:

1. Lumber for bracing, shoring, or supporting forms shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20. All lumber used for forms, shoring or bracing shall be new material.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine high density overlaid (HDO) plywood manufactured especially for concrete formwork and shall conform to the requirements of PS1 for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8-inch thick.

C. Other form materials such as metal, fiberglass, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade indicated may be submitted to the Engineer for approval, but only materials that will produce a smooth form finish equal or better than the wood materials specified will be considered.

2.02 FORMWORK ACCESSORIES

A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 7/8-inch, and all such fasteners shall be such as to leave holes of regular shape for reaming.

B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. A preformed mechanical EPDM rubber plug shall be used to seal the hole left after the removal of the taper tie. Plug shall be X-Plug by the Greenstreak Group, Inc., or approved equal. Friction fit plugs shall not be used.

C. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "bug holes" in cast-in-place concrete.

PART 3 – EXECUTION

3.01 FORM DESIGN

A. Forms and falsework shall be designed for total dead load, plus all construction live load as outlined in ACI 347. Design and engineering of formwork and safety considerations during construction shall be the responsibility of the Contractor.

B. Forms shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.

C. All forms shall be designed for predetermined placing rates per hour, considering expected air temperatures and setting rates.

3.02 CONSTRUCTION

A. The type, size, quality, and strength of all materials from which forms are made shall be subject to the approval of the Engineer. No falsework or forms shall be used which are not clean and suitable. Deformed, broken or defective falsework and forms shall be removed from the work.

B. Forms shall be smooth and free from surface irregularities. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Joints between the forms shall be sealed to eliminate any irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum.

C. Forms shall be true to line and grade, and shall be sufficiently rigid to prevent displacement and sagging between supports. Curved forms shall be used for curved and circular structures. Straight panels joined at angles will not be acceptable for forming curved structures. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. Facing material shall be supported with studs or other backing which shall prevent both visible deflection marks in the concrete and deflections beyond the tolerances specified.

D. Forms shall be mortar tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2 inch diameter polyethylene rod held in position to the underside of the wall form.

E. All vertical surfaces of concrete members shall be formed, and side forms shall be provided for all footings, slab edges and grade beams, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

F. All forms shall be constructed in such a manner that they can be removed without hammering or prying against the concrete. Wood forms shall be constructed for wall openings to facilitate loosening and to counteract swelling of the forms.

G. Adequate clean-out holes shall be provided at the bottom of each lift of forms. Temporary openings shall be provided at the base of column forms and wall forms and at other points to facilitate cleaning and observation immediately before the concrete is deposited. The size, number and location of such clean-outs shall be as acceptable to the Engineer.

H. Construction joints shall not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. For flush surfaces at construction joints exposed to view, the contact surface of the form sheathing over the hardened concrete in the previous placement shall be lapped by not more than 1 inch. Forms shall be held against hardened concrete to prevent offset or loss of mortar at construction joints and to maintain a true surface.

I. The formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads. Set forms and intermediate screed strips for slabs accurately to produce the designated elevations and contours of the finished surface. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment. When formwork is cambered, set screeds to a like camber to maintain the proper concrete thickness.

J. Positive means of adjustment (wedges or jacks) for shores and struts shall be provided and all settlement shall be taken up during concrete placing operation. Shores and struts shall be securely braced against lateral deflections. Wedges shall be fastened firmly in place after final adjustment of forms prior to concrete placement. Formwork shall be

anchored to shores or other supporting surfaces or members to prevent upward or lateral movement of any part of the formwork system during concrete placement. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

K. Runways shall be provided for moving equipment with struts or legs. Runways shall be supported directly on the formwork or structural member without resting on the reinforcing steel.

3.03 TOLERANCES

A. Unless otherwise indicated in the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in ACI 117.

B. Structural framing of reinforced concrete around elevators and stairways shall be accurately plumbed and located within 1/4 in. tolerance from established dimensions.

C. The Contractor shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and bench marks to be used for reference purposes to check tolerances. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

D. Regardless of the tolerances specified, no portion of the building shall extend beyond the legal boundary of the building.

3.04 FORM ACCESSORIES

A. Suitable moldings shall be placed to bevel or round all exposed corners and edges of beams, columns, walls, slabs, and equipment pads. Chamfers shall be 3/4 inch unless otherwise noted.

B. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 inches from the formed face of the concrete that is exposed to water or enclosed surfaces above the water surface, and not less than 1 inch from the formed face of all other concrete. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified in Section 03 35 00 – Concrete Finishes. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete member. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. No snap ties shall be broken off until the concrete is at least three days old. If steel panel forms are

used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste.

3.05 APPLICATION – FORM RELEASE AGENT

A. Forms for concrete surfaces that will not be subsequently waterproofed shall be coated with a form release agent. Form release agent shall be applied on formwork in accordance with manufacturer's recommendations.

3.06 INSERTS AND EMBEDDED ITEMS

A. Sleeves, pipe stubs, inserts, anchors, expansion joint material, waterstops, and other embedded items shall be positioned accurately and supported against displacement prior to concreting. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

3.07 FORM CLEANING AND REUSE

A. The inner faces of all forms shall be thoroughly cleaned prior to concreting. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.08 FORM REMOVAL AND SHORING

A. Forms shall not be disturbed until the concrete has attained sufficient strength. Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of forming and shoring system, and concrete strength data. Shoring shall not be removed until the supported member has acquired sufficient strength to support its weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to sustain all resulting stresses. Forms shall be removed in such manner as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.

B. Provided the strength requirements specified above have been met and subject to the Engineer's approval, forms may be removed at the following minimum times. The Contractor shall assume full responsibility for the strength of all such components from which forms are removed prior to the concrete attaining its full design compressive strength. Shoring may be required at the option of the Engineer beyond these periods.

Ambient Temperature (°F.) During Concrete Placement

	Over 95°	**70°-95°**	**60°-70°**	**50°-60°**	**Below 50°**
Walls	5 days	2 days	2 days	3 days	Do not remove until directed by Engineer (7 days minimum)
Columns	7 days	2 days	3 days	4 days	

Ambient Temperature (°F.) During Concrete Placement

	Over 95°	70°-95°	60°-70°	50°-60°	Below 50°
Beam Soffits	10 days	7 days	7 days	7 days	
Elevated Slabs	12 days	7 days	7 days	7 days	

C. When, in the opinion of the Engineer, conditions of the work or weather justify, forms may be required to remain in place for longer periods of time.

D. An accurate record shall be maintained by the Contractor of the dates of concrete placings and the exact location thereof and the dates of removal of forms. These records shall be available for inspection at all times at the site, and two copies shall be furnished the Engineer upon completion of the concrete work.

3.09 RESHORING

A. When reshoring is permitted or required the operations shall be planned in advance and subjected to approval by the Engineer.

B. Reshores shall be placed after stripping operations are complete but in no case later than the end of the working day on which stripping occurs.

C. Reshoring for the purpose of early form removal shall be performed so that at no time will large areas of new construction be required to support their own weight. While reshoring is under way, no construction or live loads shall be permitted on the new construction. Reshores shall be tightened to carry their required loads but they shall not be overtightened so that the new construction is overstressed. Reshores shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise specified.

D. For floors supporting shores under newly placed concrete, the original supporting shores shall remain in place or reshores shall be placed. The shoring or reshoring system shall have a capacity sufficient to resist the anticipated loads and, in all cases, shall have a capacity equal to at least one-half of the capacity of the shoring system above. Reshores shall be located directly under a reshore position above unless other locations are permitted.

E. In multi-story buildings, reshoring shall extend over a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads so the design superimposed loads of the floors supporting shores are not exceeded.

END OF SECTION

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SECTION 03 15 00
CONCRETE ACCESSORIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor and equipment required to provide all concrete accessories including waterstops, expansion joint material, joint sealants, expansion joint seals, contraction joint inserts, and epoxy bonding agent.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 15 16 – Joints in Concrete

C. Section 03 30 00 – Cast-in-Place Concrete

D. Section 07 90 00 – Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

2. ASTM D412 – Standard Tests for Rubber Properties in Tension

3. ASTM D 624 – Standard Test method for Rubber Property - Tear Resistance

4. ASTM D 638 – Standard Test Method for Tensile Properties of Plastics

5. ASTM D1751 – Standard Specifications for Preformed Expansion Joint fillers for Concrete Paving and Structural Construction (non-extruding and resilient bituminous types)

6. ASTM D 1752 – Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

7. ASTM D 1171 – Standard Test Method for Ozone Resistance at 500 pphm

8. ASTM D 471 – Standard Test Method for Rubber Properties

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Manufacturer's literature on all products specified herein including material certifications.

2. Proposed system for supporting PVC waterstops in position during concrete placement.

3. Samples of products if requested by the Engineer.

PART 2 – PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) WATERSTOPS

A. PVC waterstops for construction joints shall be flat ribbed type, 6 inches wide with a minimum thickness at any point of 3/8 inches.

B. Waterstops for expansion joints shall be ribbed with a center bulb. They shall be 9 inches wide with a minimum thickness at any point of 3/8 inch unless shown or specified otherwise. The center bulb shall have a minimum outside diameter of 1 inch and a minimum inside diameter of 1/2 inch.

C. The waterstops shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material or pigment whatsoever. The properties of the polyvinyl chloride compound used, as well as the physical properties of the waterstops, shall exceed the requirements of the U.S. Army Corps. of Engineers' Specification CRD-C572. The waterstop material shall have an off-white, milky color.

D. The required minimum physical characteristics for this material are:

1. Tensile strength – 1,750 psi (ASTM D-638).

2. Ultimate elongation – not less than 280% (ASTM D-638).

E. No reclaimed PVC shall be used for the manufacturing of the waterstops. The Contractor shall furnish certification that the proposed waterstops meet the above requirements.

F. PVC waterstops shall be as manufactured by BoMetals, Inc., DuraJoint Concrete Accessories, or Sika Greenstreak.

G. All waterstop intersections, both vertical and horizontal, shall be made from factory fabricated corners and transitions. Only straight butt joint splices shall be made in field.

2.02 WATERPROOF MEMBRANE PATCH

A. Waterproof membrane patch shall be Sikadur Combiflex by Sika Corporation or approved equal. Minimum width of waterstop material shall be twelve (12) inches unless shown otherwise on Contract Drawings.

2.03 EXPANDING RUBBER WATERSTOP

A. Expanding rubber shall be designed to expand under hydrostatic conditions. Waterstops shall be Adeka Ultra Seal MC-2010MN by Adeka Ultra Seal/OCM, Inc., or Hydrotite CJ-1020-2K by Sika Greenstreak, for concrete thickness greater than nine inches. For thicknesses less than nine inches, Adeka Ultra Seal KBA-1510FP or Hydrotite CJ-1020-2K shall be used.

B. Waterstop shall be a chemically modified natural rubber product with a hydrophilic agent.

C. Waterstop shall have a stainless steel mesh or coextrusion of non-hydrophilic rubber to direct expansion in the thickness direction and restrict the expansion in the longitudinal direction.

2.04 WATERSTOP ADHESIVE

A. Adhesive between waterstops and existing concrete shall be Neoprene Adhesive 77-198 by JGF Adhesives, Sikadur 31 Hi-Mod Gel by Sika Corporation, DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

B. Hydrophilic, non-bentonite water swelling elastic sealant shall be used to bond expanding rubber waterstops to rough surfaces. Hydrophilic elastic sealant shall be P-201 by Adeka Ultra Seal/OCM, Inc., Leakmaster LV-1 by Sika Greenstreak, or approved equal.

2.05 JOINT SEALANTS

A. Joint sealants shall comply with Section 07 90 00 – Joint Fillers, Sealants, and Caulking.

2.06 EXPANSION JOINT MATERIAL

A. Preformed expansion joint material shall be non-extruding, and shall be of the following types:

1. Type I – Sponge rubber, conforming to ASTM D1752, Type I.

2. Type II –Cork, conforming to ASTM D1752, Type II.

3. Type III – Self-expanding cork, conforming to ASTM D1752, Type III.

4. Type IV – Bituminous fiber, conforming to ASTM Designation D1751.

2.07 EXPANSION JOINT SEAL

A. Expansion Joint Seal System shall consist of a preformed neoprene profile, installed using the same dimensions as the joint gap, bonded with a two-component epoxy adhesive and pressurized during the adhesive cure time.

B. The expansion joint system shall be Hydrozo/Jeene Structural Sealing joint system by Hydrozo/Jeene, Inc.

2.08 CONTRACTION JOINT INSERTS

A. Contraction joint inserts shall be Zip-Cap by Greenstreak Plastic Products, Zip-Joint by BoMetals, Inc. control joint formers.

2.09 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C881 and shall be Sikadur 32 Hi-Mod, Sika Corporation, Lyndhurst, N.J.; Euco #452 Epoxy System, Euclid Chemical Company, Cleveland, OH, MasterInject 1500 by BASF Master Builder Solutions (BASF).

2.10 EPOXY RESIN BINDER

A. Epoxy resin binder shall conform to the requirements of ASTM C-881, Type III, Grade 3, Class B and C for epoxy resin binder and shall be Sikadur 23, Low-Mod-Gel, manufactured by the Sika Corporation, Lyndhurst, N.J., Flexocrete Gel manufactured by DuraJoint Concrete Accessories or Euco #352 Gel, Euclid Chemical Company, MasterEmaco ADH 327 or 327 RS by BASF Master Builder Solutions.

2.11 BEARING PADS

A. Neoprene bearing pads shall conform to requirements of A4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be nonlaminated pads having a nominal Shore A durometer hardness of 70 in accordance with ASTM D2240. Adhesive for use with neoprene pads shall be an epoxy-resin compound compatible with the neoprene having a sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikadur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

PART 3 – EXECUTION

3.01 PVC WATERSTOPS

A. PVC waterstops shall be provided in all construction and expansion joints in water bearing structures and at other such locations as required by the Drawings.

B. Waterstops shall be carefully positioned so that they are embedded to an equal depth in concrete on both sides of the joint. They shall be kept free from oil, grease, mortar or other foreign matter. To ensure proper placement, all waterstops shall be secured in correct position at 12" on center along the length of the waterstop on each side, prior to placing concrete. Such method of support shall be submitted to the Engineer for review and approval. Grommets or small pre-punched holes as close to the edges as possible will be acceptable for securing waterstops.

C. Splices in PVC waterstops shall be made with a thermostatically controlled heating element. Only straight butt joint splices will be allowed in the field. Factory fabricated corners and transitions shall be used at all intersections. Splices shall be made in strict accordance with the manufacturer's recommended instructions and procedures. At least three satisfactory sample splices shall be made on the site. The Engineer may require tests on these splices by an approved laboratory. The splices shall exhibit not less than 80 percent of the strength of the unspliced material.

D. All splices in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, discoloration, charring, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said review and all faulty material shall be removed from the site and disposed of by the Contractor at no additional cost to the Owner.

E. Waterstop installation and splicing defects which are unacceptable include, but are not limited to the following:

1. Tensile strength less than 80 percent of parent material.

2. Overlapped (not spliced) Waterstop.

3. Misalignment of waterstop geometry at any point greater than 1/16 inch.

4. Visible porosity or charred or burnt material in weld area.

5. Visible signs of splice separation when splice (24 hours or greater) is bent by hand at sharp angle.

3.02 WATERPROOF MEMBRANE PATCH AND EXPANDING RUBBER WATERSTOPS

A. Patches and waterstops shall be installed only where shown on the Drawings.

B. Patches and waterstops shall be installed in strict accordance with manufacturer's recommendations.

3.03 WATERSTOP ADHESIVE

A. Adhesive shall be applied to both contact surfaces in strict accordance with manufacturer's recommendations.

B. Adhesive shall be used where waterstops are attached to existing concrete surfaces.

3.04 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.

B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.

C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.

E. Type 1 joint sealant shall be used in all expansion and contraction joints in concrete, except where Type 8 is required as stated below, and wherever else specified or shown on the Drawings. It shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.

F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.

3.05 EXPANSION JOINT SEAL

A. The expansion joint seal system shall be installed as shown on the Drawings in strict accordance with the manufacturer's recommendations.

3.06 CONTRACTION JOINT INSERTS

A. For contraction joints in slabs, inserts shall be floated in fresh concrete during finishing.

B. For contraction joints in walls, inserts shall be secured in place prior to casting wall.

C. Inserts shall be installed true to line at the locations of all contraction joints as shown on the Drawings.

D. Inserts shall extend into concrete sufficient depth as indicated on the Drawings or specified in Section 03 15 16 – Joints in Concrete.

E. Inserts shall not be removed from concrete until concrete has cured sufficiently to prevent chipping or spalling of joint edges due to inadequate concrete strength.

3.07 EPOXY BONDING AGENT

A. The Contractor shall use an epoxy bonding agent for bonding fresh concrete to existing concrete as shown on the Drawings.

B. Bonding surface shall be clean, sound and free of all dust, laitance, grease, form release agents, curing compounds, and any other foreign particles.

C. Application of bonding agent shall be in strict accordance with manufacturer's recommendations.

D. Fresh concrete shall not be placed against existing concrete if epoxy bonding agent has lost its tackiness.

3.08 EPOXY RESIN BINDER

A. Epoxy resin binder shall be used to seal all existing rebar cut and burned off during demolition operations. Exposed rebar shall be burned back 1/2-inch minimum into existing concrete and the resulting void filled with epoxy resin binder.

3.09 BEARING PADS

A. Care shall be taken in fabricating pads and related metal parts so effects detrimental to the proper performance of the pads, such as uneven bearing and excessive bulging, will not occur.

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SECTION 03 15 16
JOINTS IN CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENTS

A. Provide all materials, labor and equipment required for the construction of all joints in concrete specified herein and shown on the Drawings.

B. Types of joints in concrete shall be as follows:

1. Construction Joints - Joints between adjacent concrete placements continuously connected with reinforcement.

2. Expansion Joints - Joints in concrete which allow thermal expansion and contraction of concrete. Reinforcement terminates within concrete on each side of joint.

3. Contraction Joints - Joints formed in concrete to provide a weakened plane in concrete section to control formation of shrinkage cracks.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 15 00 – Concrete Accessories

C. Section 03 30 00 – Cast-in-Place Concrete

D. Section 07 90 00 – Joint Fillers, Sealants and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ACI 301 – Specifications for Structural Concrete for Buildings

2. ACI 318 – Building Code Requirements for Structural Concrete

3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures

4. ACI 224.3 – Joints in Concrete Construction

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Layout drawings showing location and type of all joints to be placed in each structure.

2. Details of proposed joints in each structure.

3. For sawcut contraction joints submit documentation indicating the following:

a. Proposed method of sawcutting indicating early entry or conventional sawing.

b. Description of how work is to be performed including equipment to be utilized, size of crew performing the work and curing methods.

c. Description of alternate method in case of time constraint issues or failure of equipment.

PART 2 – MATERIALS

2.01 MATERIALS

A. All materials required for joint construction shall comply with Section 03 15 00 - Concrete Accessories, and Section 07 90 00 – Joint Fillers, Sealants and Caulking.

PART 3 – EXECUTION

3.01 CONSTRUCTION JOINTS

A. Construction joints shall be as shown on the Drawings. Otherwise, Contractor shall submit description of the joint and its location to Engineer for approval.

B. Unless noted otherwise on the Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

C. Maximum distance between horizontal joints in slabs and vertical joints in walls shall be 45'-0". For exposed walls with fluid or earth on the opposite side, the spacing between vertical and horizontal joints shall be a maximum of 25’-0”.

D. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five feet from a corner.

E. All reinforcing steel and welded wire fabric shall be continued across construction joints. Keys and inclined dowels shall be provided as shown on the Drawings or as directed by the Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.

F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

3.02 EXPANSION JOINTS

A. Size and location of expansion joints shall be as shown on the Drawings.

B. All expansion joints in water-bearing structures shall have a center-bulb type waterstop. All expansion joints below grade in walls or slabs which enclose an accessible area shall have a center-bulb type waterstop. Waterstop shall be as shown on Drawings and specified in Section 03 15 00, Concrete Accessories.

3.03 CONTRACTION JOINTS

A. Location of contraction joints shall be as shown on the Drawings.

B. Contraction joints shall be formed either by sawcutting or with contraction joint inserts as specified in Section 03 15 00 – Concrete Accessories. Sawcutting of joints will not be permitted unless specifically approved by the Engineer.

C. If approved by the Engineer, sawcutting of contraction joints in lieu of forming shall conform to the following requirements:

1. Joints shall be sawed as soon as the concrete can support foot traffic without leaving any impression, normally the same day as concrete is placed and in no case longer than 24 hours after concrete is placed.

2. Curing shall be performed using wet curing methods as indicated in Section 03 39 00 – Concrete Curing. Curing mats, fabrics or sheeting materials shall remain in place to the extent possible while cutting of joint is being performed. Curing materials shall only be removed as required and shall be immediately reinstalled once cutting of the joint has been completed.

3. Depth of joint shall be as shown on the drawings or noted in these specifications. At locations where the joint cannot be installed to full depth due to curbs or other stopping points hand tools shall be used to complete joints.

4. Saw cut joints shall meet the requirements of ACI 224.3, Section 2.8, Jointing Practice.

D. Unless noted otherwise on Drawings, depth of contraction joints shall be 1-1/2 inches in reinforced concrete and 1/3 of concrete thickness in unreinforced concrete.

3.04 JOINT PREPARATION

A. No concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

B. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed by wire brushing, air or light sand blasting.

C. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surface shall present a clean and even appearance.

D. All joints shall be sealed as shown on the Drawings and specified in Section 03 15 00 – Concrete Accessories.

END OF SECTION

SECTION 03 21 00
REINFORCING STEEL

PART 1 – GENERAL

1.01 THE REQUIREMENTS

A. Provide all concrete reinforcing including all cutting, bending, fastening and any special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion in accordance with the requirements of this section.

B. Provide deformed reinforcing bars to be grouted into reinforced concrete masonry walls.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 15 00 – Concrete Accessories

C. Section 03 30 00 – Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Georgia Building Code

2. CRSI - Concrete Reinforcing Institute Manual of Standard Practice

3. ACI SP66 - ACI Detailing Manual

4. ACI 315 - Details and Detailing of Concrete Reinforcing

5. ACI 318 - Building Code Requirements for Structural Concrete

6. ICC-ES AC193 - Acceptance Criteria for Expansion and Screw Anchors (Concrete)

7. WRI - Manual of Standard Practice for Welded Wire Fabric

8. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing

9. ASTM A 1064 - Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66), shall be furnished for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, spacing and splicing of the bars.

2. Mill test certificates - 3 copies of each.

3. Description of the reinforcing steel manufacturer's marking pattern.

4. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.

5. Proposed supports for each type of reinforcing.

6. Request to use splices not shown on the Drawings.

7. Request to use mechanical couplers along with manufacturer's literature on mechanical couplers with instructions for installation, and certified test reports on the couplers' capacity.

8. Request for placement of column dowels without the use of templates.

9. Request and procedure to field bend or straighten partially embedded reinforcing.

10. International Code Council–Evaluation Services Report (ICC-ES ESR) for dowel adhesives.

11. Certification that all installers of dowel adhesive are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.

12. Adhesive dowel testing plan.

1.05 QUALITY ASSURANCE

A. If requested by the Engineer, the Contractor shall provide samples from each load of reinforcing steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the Owner. Costs of additional tests due to material failing initial tests shall be paid by the Contractor.

B. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information.

C. Provide a copy of the current ACI/CRSI "Adhesive Anchor Installer" certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.

D. Inspections of the adhesive dowel system may be made by the engineer or other representatives of the owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injection, installation, and proof testing.

PART 2 – PRODUCTS

2.01 REINFORCING STEEL

A. Bar reinforcing shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel reinforcing. All reinforcing steel shall be from domestic mills and shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on Drawings.

B. Welded wire fabric reinforcing shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings.

C. A certified copy of the mill test on each load of reinforcing steel delivered showing physical and chemical analysis shall be provided, prior to shipment. The Engineer reserves the right to require the Contractor to obtain separate test results from an independent testing laboratory in the event of any questionable steel. When such tests are necessary because of failure to comply with this Specification, such as improper identification, the cost of such tests shall be borne by the Contractor.

D. Field welding of reinforcing steel will not be allowed.

E. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORIES

A. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers and other devices to position reinforcing during concrete placement. Wire bar supports shall be plastic protected (CRSI Class 1).

B. Concrete blocks (dobies), used to support and position bottom reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located.

2.03 MECHANICAL COUPLERS

A. Mechanical couplers shall develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied.

C. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are Dayton Superior Dowel Bar Splicer System by Dayton Superior, Dayton, Ohio, or approved equal. Mechanical couplers shall only be used where shown on the Drawings or where specifically approved by the Engineer.

D. Where the threaded rebar to be inserted into the coupler reduces the diameter of the bar, the threaded rebar piece shall be provided by the coupler manufacturer.

2.04 DOWEL ADHESIVE SYSTEM

A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.

B. All holes shall be drilled in accordance with the manufacturer’s instructions except that core drilled holes shall not be permitted unless specifically allowed by the Engineer. Cored holes, if allowed by the manufacturer and approved by the Engineer, shall be roughened in accordance with manufacturer’s requirements.

C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer’s instructions prior to installation of adhesive and reinforcing bar.

D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.

E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer’s instructions.

F. Embedment Depth:

1. The embedment depth of the bar shall be as shown on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on “Pure 110+” by DeWalt” ESR 3298 issued 7/2016. If the Contractor submits one of the other named dowel adhesives from the list below, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer’s ICC-ES ESR.

3. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer’s ICC-ES ESR.

G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.

H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete in all Seismic Design Categories and shall be "Epcon C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, " HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. “SET-XP Epoxy Adhesive Anchors” as manufactured by Simpson Strong-Tie Co. or “Pure 110+ Epoxy Adhesive Anchor System” by DeWalt. Fast-set epoxy formulations shall not be acceptable. No or equal products will be considered, unless pre-qualified and approved.

I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

PART 3 – EXECUTION

3.01 TEMPERATURE REINFORCING

A. Unless otherwise shown on the Drawings or in the absence of the concrete reinforcing being shown, the minimum cross sectional area of horizontal and vertical concrete reinforcing in walls shall be 0.0033 times the gross concrete area and the minimum cross sectional area of reinforcing perpendicular to the principal reinforcing in slabs shall be 0.0020 times the gross concrete area. Temperature reinforcing shall not be spaced further apart than five times the slab or wall thickness, nor more than 18 inches.

3.02 FABRICATION

A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.

B. The Contractor shall fabricate reinforcing bars for structures in accordance with the bending diagrams, placing lists and placing Drawings.

C. No fabrication shall commence until approval of Shop Drawings has been obtained. All reinforcing bars shall be shop fabricated unless approved to be bent in the field. Reinforcing bars shall not be straightened or rebent in a manner that will injure the material. Heating of bars will not be permitted.

D. Welded wire fabric with longitudinal wire of W9.5 size or smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

3.03 DELIVERY, STORAGE AND HANDLING

A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

B. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.

C. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

3.04 PLACING

A. Reinforcing steel shall be accurately positioned as shown on the Drawings and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or plastic protected (CRSI Class 1) metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous.

B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.

C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

D. Reinforcing bars additional to those shown on the Drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcing in position, shall be provided by the Contractor at no additional cost to the Owner.

E. Reinforcing placing, spacing, and protection tolerances shall be within the limits specified in ACI 318 except where in conflict with the Building Code, unless otherwise specified.

F. Reinforcing bars may be moved within one bar diameter as necessary to avoid interference with other concrete reinforcing, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed placing tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.

G. Welded wire fabric shall be supported on slab bolsters spaced not less than 30 inches on centers, extending continuously across the entire width of the reinforcing mat and supporting the reinforcing mat in the plane shown on the Drawings.

H. Reinforcing shall not be straightened or rebent unless specifically shown on the drawings. Bars with kinks or bends not shown on the Drawings shall not be used. Coiled reinforcement shall not be used.

I. Dowel Adhesive System shall be installed in strict conformance with the manufacturer's recommendations and as required in Article 2.04 above. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.

J. All adhesive dowel installations in the horizontal or overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-11 9.2.2. Current AAI Certificated must be submitted to the Engineer of Record for approval prior to commencement of any adhesive anchor installations.

K. Adhesive Dowel Testing

1. At all locations where adhesive dowels are shown on the Drawings, at least 25 percent of all adhesive dowels installed shall be tested to the value indicated on

the Drawings, with a minimum of one tested dowel per group. If no test value is indicated on the Drawings but the installed dowel is under direct tension, the Contractor shall notify the Engineer to verify the required test value.

2. Contractor shall submit a plan and schedule indicating locations of dowels to be tested, load test values and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. The testing equipment shall have a minimum of three support points and shall be of sufficient size to locate the edge of supports no closer than two times the anchor embedment depth from the center of the anchor.

3. Where Contract Documents indicate adhesive dowel design is the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the State of Georgia. The Contractor shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable.

4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the dowel after loading shall be considered a failure. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be proof tested.

5. Proof testing of adhesive dowels shall be performed by an independent testing laboratory hired directly by the Contractor. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.

3.05 SPLICING

A. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcing at points other than where shown, the splice shall be as acceptable to the Engineer.

B. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318 for a class B splice.

C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

D. Mechanical splices shall be used only where shown on the drawings or when approved by the Engineer.

E. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Drawings. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

3.06 INSPECTION

A. The Contractor shall advise the Engineer of his intentions to place concrete and shall allow him adequate time to inspect all reinforcing steel before concrete is placed.

B. The Contractor shall advise the Engineer of his intentions to place grout in masonry walls and shall allow him adequate time to inspect all reinforcing steel before grout is placed.

3.07 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into structural concrete without prior approval.

END OF SECTION

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Provide all labor, equipment, materials and services necessary for the manufacture, transportation and placement of all plain and reinforced concrete work, as shown on the Drawings or as ordered by the Engineer.

B. The requirements in this section shall apply to the following types of concrete:

1. Class A1 Concrete: Normal weight structural concrete to be used in all structures and pavements.

2. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 21 00 – Reinforcing Steel

C. Section 03 15 00 – Concrete Accessories

D. Section 03 15 16 – Joints in Concrete

E. Section 03 35 00 – Concrete Finishes

F. Section 03 39 00 – Concrete Curing

G. Section 03 60 00 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. 2018 International Building Code with 2020 Georgia Amendments

2. ACI 214 – Guide to Evaluation of Strength Test Results of Concrete

3. ACI 301 – Specifications for Structural Concrete

4. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete

5. ACI 305 – Guide to Hot Weather Concreting

6. ACI 306 – Guide to Cold Weather Concreting

7. ACI 309 – Guide for Consolidation of Concrete

8. ACI 318 – Building Code Requirements for Structural Concrete and Comentary

9. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures

10. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field

11. ASTM C 33 – Standard Specification for Concrete Aggregates

12. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

13. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

14. ASTM C 88 – Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate

15. ASTM C 94 – Standard Specification for Ready-Mixed Concrete

16. ASTM C 114 – Standard Test Method for Chemical Analysis of Hydraulic Cement

17. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

18. ASTM C 138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

19. ASTM C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete

20. ASTM C 150 – Standard Specification for Portland Cement

21. ASTM C 172 – Standard Practice for Sampling Freshly Mixed Concrete

22. ASTM C 192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

23. ASTM C 231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

24. ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete

25. ASTM C 295 – Standard Guide for Petrographic Examination of Aggregates for Concrete

26. ASTM C 457 – Standard Test Method for Microscopical Determination of the Air-Void System in Hardened Concrete

27. ASTM C 494 – Standard Specification for Chemical Admixtures for Concrete

28. ASTM C 595 – Standard Specification for Blended Hydraulic Cements

29. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

30. ASTM C 989 – Standard Specification for Slag Cement for Use in Concrete and Mortars

31. ASTM C 1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

32. ASTM C 1260 – Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)

33. ASTM C 1567 – Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

34. ASTM C 1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

35. ASTM C 1778 – Reducing the Risk of Deleterious Alkali – Aggregate Reaction in Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Sources of all materials and certifications of compliance with specifications for all materials.

2. Certified current (less than 1 year old) chemical analysis of the Portland Cement or Blended Cement to be used.

3. Certified current (less than 1 year old) chemical analysis of fly ash or slag cement to be used.

4. Aggregate test results showing compliance with required standards, i.e., sieve analysis, potential reactivity, aggregate soundness tests, petrographic analysis, mortar bar expansion testing, etc.

5. Manufacturer's data on all admixtures stating compliance with required standards.

6. Concrete mix design for each class of concrete specified herein.

7. Field experience records and/or trial mix data for the proposed concrete mixes for each class of concrete specified herein.

1.05 QUALITY ASSURANCE

A. Tests on materials used in the production of concrete shall be required as specified in Part 2 – Products. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the Owner.

B. Trial concrete mixes shall be tested when required in accordance with Article 3.01 at no additional cost to the Owner.

C. Field quality control tests, as specified in Article 3.10, unless otherwise stated, will be performed by a materials testing consultant approved by the Engineer and employed by the Contractor The Contractor shall also be responsible for the cost of any additional tests and investigation on work performed which does not meet the Specifications and as required by the Engineer. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

PART 2 – PRODUCTS

2.01 HYDRAULIC CEMENT

A. Portland Cement

1. Portland Cement shall be Type II conforming to ASTM C 150. Type I cement may be used provided either fly ash or slag cement is also included in the mix in accordance with Articles 2.02 or 2.03 respectively.

2. When potentially reactive aggregates as defined in Article 2.05 are to be used in concrete mix, cement shall meet the following requirements:

   a. For concrete mixed with only Portland Cement, the total alkalies in the cement (calculated as the percentage of NA2O plus 0.658 times the percentage of K2O) shall not exceed 0.40%.

b. For concrete mixed with Portland Cement and an appropriate amount of fly ash (Article 2.02) or slag cement (Article 2.03) the total alkalies in the Portland Cement (calculated as the percentage of NA2O plus 0.658 times the percentage of K2O) shall not exceed 0.85%.

3. When non-reactive aggregates as defined in Article 2.05 are used in concrete mix, total alkalies in the cement shall not exceed 1.0%.

4. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

B. Blended Cement

1. Blended cements shall be Type IP (Portland Fly Ash Cement) or Type IS (Portland Slag Cement) conforming to ASTM C 595.

2. Type IP cement shall be an interground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.

3. Type IS cement shall be an interground blend of Portland Cement and slag cement in which the slag constituent is between 35% and 50% of the weight of the total blend.

4. Fly ash and slag cement used in the production of blended cements shall meet the requirements of Articles 2.02 and 2.03, respectively.

5. When reactive aggregates as defined in Article 2.05 are used in concrete mix, the total alkalies in the Portland Cement (calculated as the percentage of Na2O plus 0.658 times the percentage of K2O) shall not exceed 0.85%. The percentage of fly ash or slag cement shall be set to meet provisions of Article 2.05.G.2.

C. Different types of cement shall not be mixed nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project.

D. Cement shall be stored in a suitable weather-tight building so as to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.02 FLY ASH

A. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618.

B. For fly ash to be used in the production of type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C 595.

C. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the fly ash constituent shall be between 15% and 25% of the total weight of the combined Portland Cement and fly ash. The percentage of fly ash shall be set to meet the mean mortar bar expansion requirements in provisions of Article 2.05.G.2.

D. For Type A1 concrete inclusion of fly ash or slag cement in the concrete mix, is mandatory.

E. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

2.03 SLAG CEMENT

A. Slag cement shall meet the requirements of ASTM C 989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C 989.

B. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the slag cement constituent shall be between 35% and 40% of the total weight of the combined Portland Cement and slag. The percentage of slag cement shall be set to meet the mean mortar bar expansion requirements in provisions of Article 2.05.G.2.

C. For Type A1 concrete inclusion of fly ash or slag cement in the concrete mix, is mandatory.

D. Additional slag cement shall not be included in concrete mixed with type IS or IP cement.

2.04 WATER

A. Water used for mixing concrete shall be clear, potable and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts and other impurities.

B. Water shall not contain more than 100 PPM chloride.

C. Water shall not contain more than 500 PPM dissolved solids.

D. Water shall have a pH in the range of 4.5 to 8.5.

E. Water shall meet requirements of ASTM C 1602.

2.05 AGGREGATES

A. All aggregates used in normal weight concrete shall conform to ASTM C 33.

B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33.

C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.

D. For Class A4 concrete, coarse aggregate shall be Size #8 in accordance with ASTM C33.

E. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C 136.

F. Aggregates shall be tested for soundness in accordance with ASTM C 88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using either magnesium sulfate or sodium sulfate.

G. All aggregates shall be evaluated in accordance with ASTM C 1778 to determine potential reactivity. All aggregates shall be considered reactive unless they meet the requirements below for non-reactive aggregates. Aggregates with a lithology essentially similar to sources in the same region found to be reactive in service shall be considered reactive regardless of the results of the tests above.

    1. Non-reactive aggregates shall meet the following requirements:

        a. A petrographic analysis in accordance with ASTM C295 shall be performed to identify the constituents of the fine and coarse aggregate. Non-reactive aggregates shall meet the following limitations:

            1) Optically strained, microfractured, or microcrystalline quartz, 5.0%, maximum.

            2) Chert or chalcedony, 3.0%, maximum.

            3) Tridymite or cristobalite, 1.0%, maximum.

            4) Opal, 0.5%, maximum.

            5) Natural volcanic glass in volcanic rocks, 3.0%, maximum.

    2. Concrete mixed with reactive aggregates shall meet the following requirements:

        a. If aggregates are deemed potentially reactive as per ASTM C-1778 and fly ash or slag cement is included in proposed concrete mix design, proposed concrete mix including proposed aggregates shall be evaluated by ASTM C-1567. Mean mortar bar expansions at 16 days shall be less than 0.08%.

Tests shall be made using exact proportion of all materials proposed for use on the job in design mix submitted.

b. If aggregates are deemed potentially reactive as per ASTM C-1778 and a straight cement mix without fly ash or slag cement is proposed for concrete mix design, aggregates shall be evaluated by ASTM C-1260. Mean mortar bar expansions at 16 days shall be less than 0.08%.

H. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

2.06 STRUCTURAL MACRO FIBERS – NOT USED

2.07 ADMIXTURES

A. Air entraining agent shall be added to all concrete unless noted otherwise. The agent shall consist of a neutralized vinsol resin solution or a purified hydrocarbon with a cement catalyst which will provide entrained air in the concrete in accordance with ASTM C 260. The admixture proposed shall be selected in advance so that adequate samples may be obtained and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.

B. The following admixtures are required or used for water reduction, slump increase, and/or adjustment of initial set. Admixtures permitted shall confirm to the requirements of ASTM C 494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air-entraining admixtures.

1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are “Eucon Series” by the Euclid Chemical Company, “Master Pozzolith Series” by BASF, and “Plastocrete Series” by Sika Corporation.

2. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G. The high range water reducer shall be added to the concrete at either the batch plant or at the job site and may be used in conjunction with a water reducing admixture. The high range water reducer shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day’s operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are “Eucon 37” or Plastol 5000 by the Euclid Chemical Company, “Master Rheobuild 1000 or Master Glenium Series” by BASF, and “Daracem 100 or Advaflow Series” by W.R. Grace.

3. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E, and shall not contain more chloride ions than are present in

municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are "Accelguard 80/90 or NCA" by the Euclid Chemical Company and "Daraset" by W.R. Grace.

4. A water reducing retarding admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type D and shall not contain more than 0.05% chloride ions. Acceptable products are "Eucon NR or Eucon Retarder 100" by the Euclid Chemical Company, "Pozzolith Retarder" by BASF, and "Plastiment" by Sika Corporation.

C. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.

D. The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review.

2.08 CONCRETE MIX DESIGN

A. The proportions of cement, aggregates, admixtures and water used in the concrete mixes shall be based on the results of field experience or preferably laboratory trial mixes in conformance with Section 5.3. "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350. When trial mixes are used they shall also conform to Article 3.01 of this Section of the Specifications. If field experience records are used, concrete strength results shall be from concrete mixed with all of the ingredients proposed for use on job used in similar proportions to mix proposed for use on job. Contractor shall submit verification confirming this stipulation has been followed. Field experience records and/or trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

B. Structural concrete shall conform to the following requirements. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.

1. Compressive Strength (28-Day)

Concrete Class A1	4,500 psi (minimum)
Concrete Class B	3,000 psi (minimum)

2. Water/cementitious materials ratio, by weight

	Maximum	Minimum
Concrete Class A1	0.42	0.37
Concrete Class B	0.50	0.39

3. Slump range

   a. 4" nominal unless high range water reducing admixture is used

   b. 8” max if high range water reducing admixture is used.

4. Air Content

Concrete Class A1	6% ±1.5%
Concrete Class B	3% Max (non air-entrained)

PART 3 – EXECUTION

3.01 TRIAL MIXES

A. When trial mixes are used to confirm the quality of a proposed concrete mix in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350, an independent qualified testing laboratory designated and retained by the Contractor shall test a trial batch of each of the preliminary concrete mixes submitted by the Contractor. The trial batches shall be prepared using the aggregates, cement and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the Owner.

B. The independent testing laboratory shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump (ASTM C 143), air content (C 231) and unit weight (C 138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. , Product ." If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected,

another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the Owner. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.

3.02 PRODUCTION OF CONCRETE

A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready mix plant or from a site mixed plant. In selecting the source for concrete production the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.

B. Ready-Mixed Concrete

1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.

2. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

4. Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

5. Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed before the drum has been revolved 300 revolutions and within the time requirements stated in Article 3.03 of this Section.

6. Each and every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:

    a. Date and truck number

    b. Ticket number

    c. Mix designation of concrete

    d. Cubic yards of concrete

    e. Cement brand, type and weight in pounds

    f. Weight in pounds of fine aggregate (sand)

    g. Weight in pounds of coarse aggregate (stone)

    h. Air entraining agent, brand, and weight in pounds and ounces

    i. Other admixtures, brand, and weight in pounds and ounces

    j. Water, in gallons, stored in attached tank

    k. Water, in gallons, maximum that can be added without exceeding design water/cementitious materials ratio

    l. Water, in gallons, actually used (by truck driver)

    m. Time of loading

    n. Time of delivery to job (by truck driver)

7. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.

8. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

C. Site Mixed Concrete

1. Scales for weighing concrete ingredients shall be accurate when in use within ±0.4 percent of their total capacities. Standard test weights shall be available to permit checking scale accuracy.

2. Operation of batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances:

a.	Cement, fly ash, or slag cement	± 1 percent
b.	Water	± 1 percent
c.	Aggregates	± 2 percent
d.	Admixtures	± 3 percent

3. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.

4. The concrete shall be mixed in a batch mixer capable of thoroughly combining the aggregates, cement, and water into a uniform mass within the specified mixing time, and of discharging the concrete without harmful segregation. The mixer shall bear a manufacturer's rating plate indicating the rate capacity and the recommended revolutions per minute and shall be operated in accordance therewith.

5. Mixers with a rate capacity of 1 cu.yd. or larger shall conform to the requirements of the Plant Mixer Manufacturers' Division of the Concrete Plant Manufacturers' Bureau.

6. Except as provided below, batches of 1 cu. yd. or less shall be mixed for not less than 1 minute. The mixing time shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity.

7. Shorter mixing time may be permitted provided performance tests made in accordance with of ASTM C 94 indicate that the time is sufficient to produce uniform concrete.

8. Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three-quarters of the required mixing time shall take place after the last of the mixing water has been added.

9. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixer blades shall be replaced when they have lost 10 percent of their original height.

10. Air-entraining admixtures and other chemical admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water.

Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer.

11. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.

12. Addition of retarding admixtures shall be completed within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Retarding admixtures shall not be used unless approved by the Engineer.

13. Concrete shall be mixed only in quantities for immediate use and within the time and mixing requirements of ASTM C 94.

3.03 CONCRETE PLACEMENT

A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.

B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice and foreign matter shall be removed from the space to be occupied by the concrete. The Contractor shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures which are subsequently required.

C. On horizontal joints where concrete is to be placed on hardened concrete, flowing concrete containing a high range water reducing admixture or cement grout shall be placed with a slump not less than 8 inches for the initial placement at the base of the wall. Concrete or cement grout shall meet all strength and service requirements specified herein for applicable class of concrete. This concrete shall be worked well into the irregularities of the hard surface.

D. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.

E. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided that the design water-cementitious materials ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall

not relieve the Contractor from furnishing a concrete mix that meets all specified requirements.

F. Concrete shall be conveyed as rapidly as practicable to the point of deposit by methods which prevent the separation or loss of the ingredients. It shall be so deposited that rehandling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed the requirements stated in Article 3.09 of this Section.

G. Where concrete is conveyed to position by chutes, a practically continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such as to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet, unless approved otherwise.

H. Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds. Concrete shall be placed in all forms in such way as to prevent any segregation.

I. Placing of concrete shall be so regulated that the pressure caused by the wet concrete shall not exceed that used in the design of the forms.

J. All concrete for walls shall be placed through openings in the form spaced at frequent intervals or through tremies (heavy duct canvas, rubber, etc.), equipped with suitable hopper heads. Tremies shall be of variable lengths so the free fall shall not exceed five (5) feet and a sufficient number shall be placed in the form to ensure the concrete is kept level at all times.

K. When placing concrete which is to be exposed, sufficient illumination shall be provided in the interior of the forms so the concrete, at places of deposit, is visible from deck and runways.

L. Concrete shall be placed so as to thoroughly embed all reinforcement, inserts, and fixtures.

M. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. To achieve this, concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.

N. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to

ride the form supporting the slab. Vibration shall be applied at the point of deposit and in the area of freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.

O. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration, however, shall not be continued in any one location to the extent that pools of grout are formed.

P. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall be such as to ensure that each layer is placed while the previous layer is soft or plastic, so that the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.

Q. To prevent featheredges, construction joints located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so the angle between such inclined surface and the exposed concrete surface will be not less than 50°.

R. In placing unformed concrete on slopes, the concrete shall be placed ahead of a non-vibrated slip-form screed extending approximately 2-1/2 feet back from its leading edge. The method of placement shall provide a uniform finished surface with the deviation from the straight line less than 1/8 inch in any concrete placement. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators so as to ensure complete filling under the slip-form. Prior to placement of concrete on sloped walls or slabs, the Contractor shall submit a plan specifically detailing methods and sequence of placements, proposed concrete screed equipment, location of construction joints and waterstops, and/or any proposed deviations from the aforementioned to the Engineer for review and approval.

S. Concrete shall not be placed during rains sufficiently heavy or prolonged to wash mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

3.04 PLACING FLOOR SLABS ON GRADE

A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete shall be placed until the depth and character of the foundation soils have been inspected and approved by the materials testing consultant and the Engineer.

B. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing it shall be raised and maintained above 50° long enough to remove all frost from the subgrade.

C. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

D. Thirty pound felt paper shall be provided between edges of slab on grade and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.

E. Contraction joints shall be provided in slabs-on-grade at locations indicated on the Drawings. Contraction joints shall be installed as per Section 03 15 16 – Joints in Concrete.

F. Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings. Finishes shall conform with requirements of Section 03 35 00 – Concrete Finishes. Interior floor slabs shall be placed with non-air-entrained concrete (Class A3) if a steel troweled or hardened finish is required.

3.05 PLACING CONCRETE UNDERWATER (CLASS A5 CONCRETE)

A. Placing concrete underwater (tremie concrete) will be permitted only when shown on the Drawings. Concrete deposited under water shall be carefully placed in a compacted mass in final position by means of a tremie, a closed bottom dump bucket or other approved method. Care must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. Underwater formwork shall be watertight. The consistency of the concrete shall be regulated to prevent segregation of materials. The method of depositing concrete shall be regulated such that the concrete enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete.

B. Tremie shall consist of a tube having a diameter of not less than 10 inches and constructed in sections having flanged couplings fitted with gaskets. The tremie shall be supported to permit free movement of the discharge and over the entire top surface of the work and shall permit rapid lowering when necessary to choke off or retard the flow. The discharge end shall be entirely sealed at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow shall then be stopped by lowering the tremie. The flow shall be continuous until the placement has been completed.

3.06 PLACING CONCRETE UNDER PRESSURE

A. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. To obtain the

least line resistance, the layout of the pipeline system shall contain a minimum number of bends with no change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the concrete remaining in the pipelines, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

B. Priming of the concrete pumping equipment shall be with cement grout only. Use of specialty mix pump primers or pumping aids will not be allowed.

C. No aluminum parts shall be in contact with the concrete during the entire placing of concrete under pressure at any time.

D. Prior to placing concrete under pressure, the Contractor shall submit the concrete mix design together with test results from a materials testing consultant proving the proposed mix meets all requirements. In addition, an actual pumping test under field conditions is required prior to acceptance of the mix. This test requires a duplication of anticipated site conditions from beginning to end. The batching and truck mixing shall be the same as will be used; the same pump and operator shall be present and the pipe and pipe layouts will reflect the maximum height and distance contemplated. All submissions shall be subject to approval by the Engineer.

E. If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

F. The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.

G. The minimum diameter of the hose (conduits) shall be four inches.

H. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

I. Concrete samples for quality control in accordance with Article 3.10 will be taken at the placement (discharge) end of the line.

3.07 ORDER OF PLACING CONCRETE

A. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings and maximum lengths as indicated on Drawings. Where required on the Drawings and wherever else practical, the placing of such units shall be done in a strip pattern in accordance with ACI 302.1. A minimum of 72 hours shall pass prior to placing concrete directly adjacent to previously placed concrete.

3.08 CONCRETE WORK IN COLD WEATHER

A. Cold weather concreting procedures shall conform to the requirements of ACI 306.

B. The Engineer may prohibit the placing of concrete at any time when air temperature is 40°F. or lower. If concrete work is permitted, the concrete shall have a minimum temperature, as placed, of 55°F. for placements less than 12" thick, 50°F. for placements 12" to 36" thick, and 45°F. for placements greater than 36" thick. The temperature of the concrete as placed shall not exceed the aforementioned minimum values by more than 20°F, unless otherwise approved by the Engineer.

C. All aggregate and water shall be preheated. Precautions shall be taken to avoid the possibility of flash set when aggregate or water are heated to a temperature in excess of 100°F. in order to meet concrete temperature requirements. The addition of admixtures to the concrete to prevent freezing is not permitted. All reinforcement, forms, and concrete accessories with which the concrete is to come in contact shall be defrosted by an approved method. No concrete shall be placed on frozen ground.

3.09 CONCRETE WORK IN HOT WEATHER

A. Hot weather concreting procedures shall conform to the requirements of ACI 305.

B. When air temperatures exceed 85°F., or when extremely dry conditions exist even at lower temperatures, particularly if accompanied by high winds, the Contractor and his concrete supplier shall exercise special and precautionary measures in preparing, delivering, placing, finishing, curing and protecting the concrete mix. The Contractor shall consult with the Engineer regarding such measures prior to each day's placing operation and the Engineer reserves the right to modify the proposed measures consistent with the requirements of this Section of the Specifications. All necessary materials and equipment shall be on hand an in position prior to each placing operation.

C. Preparatory work at the job site shall include thorough wetting of all forms, reinforcing steel and, in the case of slab pours on ground or subgrade, spraying the ground surface on the preceding evening and again just prior to placing. No standing puddles of water shall be permitted in those areas which are to receive the concrete.

D. The temperature of the concrete mix when placed shall not exceed 90°F.

E. Temperature of mixing water and aggregates shall be carefully controlled and monitored at the supplier's plant, with haul distance to the job site being taken into account. Stockpiled aggregates shall, if necessary, be shaded from the sun and sprinkled intermittently with water. If ice is used in the mixing water for cooling purposes, it must be entirely melted prior to addition of the water to the dry mix.

F. Delivery schedules shall be carefully planned in advance so that concrete is placed as soon as practical after it is properly mixed. For hot weather concrete work (air

temperature greater than 85°F), discharge of the concrete to its point of deposit shall be completed within 60 minutes from the time the concrete is batched.

G. The Contractor shall arrange for an ample work force to be on hand to accomplish transporting, vibrating, finishing, and covering of the fresh concrete as rapidly as possible.

3.10 QUALITY CONTROL

A. Field Testing of Concrete

1. The Contractor shall coordinate with the Engineer's project representative the on-site scheduling of the materials testing consultant personnel as required for concrete testing.

2. Concrete for testing shall be supplied by the Contractor at no additional cost to the Owner, and the Contractor shall provide assistance to the materials testing consultant in obtaining samples. The Contractor shall dispose of and clean up all excess material.

B. Consistency

1. The consistency of the concrete will be checked by the materials testing consultant by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer and/or the materials testing consultant may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for any delays, material or labor costs due to such eventualities.

2. Slump tests shall be made in accordance with ASTM C 143. Slump tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. Concrete with a specified nominal slump shall be placed having a slump within 1” (higher or lower) of the specified slump. Concrete with a specified maximum slump shall be placed having a slump less than the specified slump.

C. Unit Weight

1. Samples of freshly mixed concrete shall be tested for unit weight by the materials testing consultant in accordance with ASTM C 138.

2. Unit weight tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the materials testing consultant in accordance with ASTM C 231.

2. Air content tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. In the event test results are outside the limits specified, additional testing shall occur. Admixture quantity adjustments shall be made immediately upon discovery of incorrect air entrainment.

E. Compressive Strength

1. Samples of freshly mixed concrete will be taken by the materials testing consultant and tested for compressive strength in accordance with ASTM C 172, C 31 and C 39, except as modified herein.

2. In general, one sampling shall be taken for each placement in excess of five (5) cubic yards, with a minimum of one (1) sampling for each day of concrete placement operations, or for each one hundred (100) cubic yards of concrete, or for each 5,000 square feet of surface area for slabs or walls, whichever is greater.

3. Each sampling shall consist of at least five (5) 6x12 cylinders or (8) 4x8 cylinders. Each cylinder shall be identified by a tag, which shall be hooked or wired to the side of the container. The materials testing consultant will fill out the required information on the tag, and the Contractor shall satisfy himself that such information shown is correct.

4. The Contractor shall furnish labor as needed to the materials testing consultant for assisting in preparing test cylinders for testing. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period of initial curing. The box shall be erected, furnished and maintained by the Contractor. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C 31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds and such that all specimens are shielded from direct sunlight and/or radiant heating sources. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours.

5. The Contractor shall be responsible for maintaining the temperatures of the curing box during the initial curing of test specimens with the temperature preserved between 60°F and 80°F as measured by a maximum-minimum thermometer. The Contractor shall maintain a written record of curing box temperatures for each day

curing box contains test specimens. Temperature shall be recorded a minimum of three times a day with one recording at the start of the workday and one recording at the end of the workday.

6. When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.

7. Compression tests shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at seven days and two at 28 days. For 4x8 cylinders, three test cylinders will be tested at seven days, three at 28 days. The remaining cylinders will be held to verify test results, if needed.

F. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214, ACI 318, and ACI 350.

2. The strength level of concrete will be considered satisfactory if all of the following conditions are satisfied.

   a. Every arithmetic average of any three consecutive strength tests equals or exceeds the minimum specified 28-day compressive strength for the mix (see Article 2.08).

   b. No individual compressive strength test results fall below the minimum specified strength by more than 500 psi.

3. In the event any of the conditions listed above are not met, the mix proportions shall be corrected for the next concrete placing operation.

4. In the event that condition 2B is not met, additional tests in accordance with Article 3.10, paragraph H shall be performed.

5. When a ratio between 7-day and 28-day strengths has been established by these tests, the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths. Should the 7-day test strength from any sampling be more than 10% below the established minimum strength, the Contractor shall:

   a. Immediately provide additional periods of curing in the affected area from which the deficient test cylinders were taken.

   b. Maintain or add temporary structural support as required.

   c. Correct the mix for the next concrete placement operation, if required to remedy the situation.

6. All concrete which fails to meet the ACI requirements, and these specifications is subject to removal and replacement at no additional cost to the Owner.

G. When non-compliant concrete is identified, test reports shall be sent immediately to the Engineer for review.

H. Additional Tests

1. When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Contractor.

2. In the event the 28-day test cylinders fail to meet the minimum strength requirements as outlined in Article 3.10, paragraph F, the Contractor shall have concrete core specimens obtained and tested from the affected area immediately.

a. Three cores shall be taken for each sample in which the strength requirements were not met.

b. The drilled cores shall be obtained and tested in conformance with ASTM C 42. The tests shall be conducted by a material testing consultant approved by the Engineer.

c. The location from which each core is taken shall be approved by the Engineer. Each core specimen shall be located, when possible, so its axis is perpendicular to the concrete surface and not near formed joints or obvious edges of a unit of deposit.

d. The core specimens shall be taken, if possible, so no reinforcing steel is within the confines of the core.

e. The diameter of core specimens should be at least 3 times the maximum nominal size of the coarse aggregate used in the concrete but must be at least 2-inches in diameter.

f. The length of specimen, when capped, shall be at least twice the diameter of the specimen.

g. The core specimens shall be taken to the laboratory and when transported, shall not be thrown, dropped, allowed to roll, or damaged in any way.

h. Two (2) copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average compressive strength of a minimum of three test core specimens taken from a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength is greater than 75% of the specified 28-day strength.

3. In the event that concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage a material testing consultant approved by the Engineer, to obtain and test samples for air content in accordance with ASTM Specification C 457.

3.11 CARE AND REPAIR OF CONCRETE

A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to the Owner.

B. Areas of honeycomb shall be chipped back to sound concrete and repaired as directed.

C. Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed.

D. Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced or repaired as directed. This stipulation includes concrete that has experienced cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an approved epoxy injection system. Non-structural cracks shall be repaired using an approved hydrophilic resin pressure injected grout system, unless other means of repair are deemed necessary and approved. All repair work shall be performed at no additional cost to the Owner.

E. Concrete which fails to meet the strength requirements as outlined in Article 3.10, paragraph F, will be analyzed as to its adequacy based upon loading conditions, resultant stresses and exposure conditions for the particular area of concrete in question. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at no additional cost to the Owner. The method of strengthening or extent of replacement shall be as directed by the Engineer.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 30 00 – Cast-in-Place Concrete

C. Section 03 60 00 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ACI 301 – Specifications for Structural Concrete for Buildings

2. ACI 318 – Building Code Requirements for Structural Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Manufacturer's literature on all products specified herein.

PART 2 – PRODUCTS

2.01 CONCRETE FLOOR SEALER

A. Floor sealer shall be Diamond Clear VOX or Super Diamond Clear VOX by the Euclid Chemical Company, MasterKure CC 300 SB by BASF Master Builder Solutions.

PART 3 – EXECUTION

3.01 FINISHES ON FORMED CONCRETE SURFACES

A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.06 - Concrete Finish Schedule. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. See Article 3.05 for surfaces to receive paint or protective coatings. The Engineer shall be the sole judge of acceptability of all concrete finish work.

1. Type I - Rough: All fins, burrs, offsets, marks and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be removed will only be those greater than ¼-inch. All holes left by removal of ends of ties, and all other holes, depressions, bugholes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be tie holes and any other holes larger than ¼-inch in any dimension. Honeycombs shall be chipped back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, epoxy bonding agent (for tie holes only) and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been predampened over an extended amount of time to reach the condition of saturated surface dry (SSD), a slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap.

3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

3.02 SLAB AND FLOOR FINISHES

A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.05 - Concrete Finish Schedule. The Engineer shall be the sole judge of acceptability of all such finish work.

1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2” minimum deep grooves prior to final set.

2. Type "B" - Wood or Magnesium Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood or magnesium float or until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and any other irregularities.

3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.

4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, the applicable Specification Sections and Contract Drawings shall be reviewed for the required finishes and degree of flatness. In areas that are intermittently wet such as pump rooms, only one troweling operation is required to provide some trowel marks for slip resistance. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.

5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish. All edges shall be edged with an 1/8-inch tool as directed by the Engineer.

6. Type "F" - Swept in Grout Topping: Not Used

7. Type “G” Hardened Finish: Not Used

8. Type "H" - Non-Slip Finish: Not Used

9. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of ±1/4 inch.

3.03 CONCRETE SEALERS

A. Concrete sealers shall be applied where specifically required on the Contract Drawings or specified herein.

B. Sealers shall be applied after installation of all equipment, piping, etc. and after completion of any other related construction activities. Application of sealers shall be in strict accordance with manufacturer's requirements.

C. Sealers shall be applied to all floor slabs not painted and not intended to be immersed.

D. Floor slabs subjected to vehicular traffic shall be sealed with the concrete liquid densifier and sealer.

E. All other floor slabs to receive sealer shall be sealed with concrete floor sealer.

3.04 FINISHES ON EQUIPMENT PADS

A. Formed surfaces of equipment pads shall receive a Type III finish.

B. Top surfaces of equipment pads, except those surfaces subsequently required to receive grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

3.05 FINISHES FOR SURFACES TO RECEIVE PAINT OR COATINGS

A. Surfaces indicated or specified to receive paint or special coatings shall be prepared per specifications in Division 09. All products applied to the concrete surfaces during the placement, finishing, and curing process shall be compatible with the painting or coating system as required by the manufacturer.

3.06 CONCRETE FINISH SCHEDULE

Item	Type of Finish
Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous concrete structures:	
From 1 feet below water surface to bottom of wall	I
From top of wall to 1 feet below water surface	II

Item	Type of Finish
Exterior concrete walls below grade	I
Exterior exposed concrete walls, ceilings, beams, manholes, hand holes, miscellaneous structures and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere	II
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E

END OF SECTION

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SECTION 03 39 00
CONCRETE CURING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Protect all freshly deposited concrete from premature drying and from the weather elements. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for a period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with the requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 11 00 – Concrete Formwork

B. Section 03 30 00 – Cast-In-Place Concrete

C. Section 03 35 00 – Concrete Finishes

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ACI 301 – Specifications for Structural Concrete for Buildings
2. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete
3. ACI 305 – Hot Weather Concreting
4. ACI 306 – Cold Weather Concreting
5. ACI 308 – Standard Practice for Curing Concrete
6. ASTM C171 – Standard Specifications for Sheet Materials for Curing Concrete
7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
8. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Proposed procedures for protection of concrete under wet weather placement conditions.

2. Proposed normal procedures for protection and curing of concrete.

3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.

4. Proposed method of measuring concrete surface temperature changes.

5. Manufacturer's literature and material certification for proposed curing compounds.

PART 2 – PRODUCTS

2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C 1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m2 when applied at 300 sq.ft./gal. Manufacturer’s certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company, MasteKure CC 300 SB by BASF Master Builder Solutions, and Cure & Seal 30 Plus by Symons Corporation.

B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C 309. Acceptable products are “Kurez DR VOX” or “Kurez W VOX” by the Euclid Chemical Company. Install in strict accordance with manufacturer’s requirements.

2.02 EVAPORATION REDUCER

A. Evaporation reducer shall be BASF, "MasterKure ER 50”, or Euclid Chemical "Euco-Bar".

PART 3 – EXECUTION

3.01 PROTECTION AND CURING

A. All freshly placed concrete shall be protected from the elements, flowing water and from defacement of any nature during construction operations.

B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for maintaining the concrete in a moist

condition for at least a 5-day period thereafter except for high early strength concrete, for which the period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, localized drying will not be permitted.

C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of five days. Use of a curing compound will not be acceptable for applications of this type.

D. The Contractor shall use one of the following methods to ensure that the concrete remains in a moist condition for the minimum period stated above.

1. Ponding or continuous fogging or sprinkling.

2. Application of mats or fabric kept continuously wet.

3. Continuous application of steam (under 150°F).

4. Application of sheet materials conforming to ASTM C171.

5. If approved by the Engineer, application of a curing compound in accordance with Article 3.04.

E. The Contractor shall keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the methods in paragraph D.

F. Any of the curing procedures used in Paragraph 3.01-D may be replaced by one of the other curing procedures listed in Paragraph 3.01-D after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Section 03 30 00 – Cast-In-Place Concrete, for concrete work in cold weather. During the 72-hour period, the concrete surface shall not be exposed to air more than 20°F above the minimum as placed temperatures.

B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or ground granulated blast furnace slag. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.

C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All

such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.

D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

A. When air temperatures exceed 85°F, the Contractor shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sun shades and/or windbreakers shall be erected to guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.

B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.

C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in paragraph 3.01D is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.

D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least six (6) additional days using one of the methods listed in paragraph 3.01D.

E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

3.04 USE OF CURING COMPOUND

A. Curing compound shall be used only where specifically approved by the Engineer. Curing compound shall never be used for curing exposed walls with fluid or earth backfill on the opposite side. A continuous wet cure for a minimum of five days is required for these applications. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.

B. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time period, and the subsequent appearance of the concrete surface shall not be affected.

C. The compound shall be applied in accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. Maximum coverage for the curing and sealing compound shall be 300 square feet per gallon for trowel finishes and 200 square feet per gallon for floated or

broom surfaces. Maximum coverage for compounds placed where subsequent finishes will be applied shall be 200 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.

3.05 EARLY TERMINATION OF CURING

A. Moisture retention measures may be terminated earlier than the specified times only when at least one of the following conditions is met:

1. The strength of the concrete reaches 85 percent of the specified 28-day compressive strength in laboratory-cured cylinders representative of the concrete in place, and the temperature of the in-place concrete has been constantly maintained at 50 degrees Fahrenheit or higher.

2. The strength of concrete reaches the specified 28-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

END OF SECTION

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SECTION 03 40 00
PRECAST CONCRETE

PART 1 – GENERAL

1.01 REQUIREMENTS

A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 33 05 61 – Utility Structures

B. Section 03 21 00 – Reinforcing Steel

C. Section 03 23 00 – Stressing Tendons

D. Section 03 30 00 – Cast-in-Place Concrete

E. Section 03 35 00 – Concrete Finishes

F. Section 03 39 00 – Concrete Curing

G. Section 03 60 00 – Grout

H. Section 05 10 00 – Metal Materials

I. Section 05 05 13 – Galvanizing

J. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the end of the Bid.

1. Georgia Building Code

2. ACI 318 – Building Code Requirements for Structural Concrete

3. ASTM D2240 – Standard Test for Rubber Property – Durometer Hardness

4. PCI Standard MNL-116 – Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products

5. PCI Design Handbook

1.04 SUBMITTALS

A. The Contractor shall submit the following for review in accordance with Section 01 33 00 – Submittal Procedures.

1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.

2. A list of the design criteria used by the manufacturer for all manufactured, precast items.

3. Design calculations, showing at least the design loads and stresses on the item, shall be submitted. Calculations shall be signed and sealed by a Professional Engineer registered in the in the State or Commonwealth in which the project is located.

4. Certified reports for all lifting inserts, indicating allowable design loads.

5. Information on lifting and erection procedures.

1.05 QUALITY ASSURANCE

A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, spalls, and cracks. Care shall be taken in the mixing of materials, casting, curing, and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the Owner.

B. Manufacturer Qualifications: The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. Certification is only required for plants providing prestressed structural members such as hollow core planks, double-T members, etc.

C. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five years' experience in precast concrete work.

PART 2 – PRODUCTS

2.01 CONCRETE

A. Concrete materials including Portland cement, aggregates, water, and admixtures shall conform to Section 03 30 00 – Cast-in-Place Concrete.

B. For prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 5,000 psi unless otherwise specified. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi unless otherwise specified.

C. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4,500 psi for fluid containing and other environmental concrete structures and 4,000 for other structural concrete structures, unless otherwise specified.

2.02 GROUT

A. Grout for joints between panels shall be a cement grout in conformance with Section 03 60 00 – Grout.

B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

2.03 REINFORCING STEEL

A. Reinforcing steel used for precast concrete construction shall conform to Section 03 21 00 – Reinforcing Steel.

2.04 PRESTRESSING STRANDS

A. Prestressing strands shall be 7-wire, stress-relieved, high-strength strands Grade 250K or 270K in conformance with Section 03 23 00 – Stressing Tendons.

2.05 STEEL INSERTS

A. Steel inserts shall be in accordance with Section 05 10 00 – Metal Materials.

B. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized in accordance with Section 05 05 13 – Galvanizing.

2.06 WELDING

A. Welding shall conform to Section 05 05 23 – Metal Fastening.

2.07 BEARING PADS

A. Neoprene bearing pads shall conform to the requirements of A4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be nonlaminated

pads having a nominal Shore A durometer hardness of 70 in accordance with ASTM D2240. Adhesive for use with neoprene pads shall be an epoxy-resin compound compatible with the neoprene having a sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikadur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

B. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast concrete.

PART 3 – EXECUTION

3.01 FABRICATION AND CASTING

A. All precast members shall be fabricated and cast to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast members shall be straight, true, and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position with the form work system. Form materials shall be steel and the systems free from leakage during the casting operation.

B. All cover of reinforcing shall be the same as detailed on the Drawings.

C. Because of the critical nature of the bond development length in prestressed concrete panel construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.

D. The Contractor shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.

E. Concrete shall be finished in accordance with Section 03 35 00 – Concrete Finishes. Grout all recesses due to cut tendons which will not otherwise be grouted during erection.

F. Curing of precast members shall be in accordance with Section 03 39 00 – Concrete Curing. Use of a membrane curing compound will not be allowed.

G. The manufacturer shall provide lifting inserts or other approved means of lifting members.

3.02 HANDLING, TRANSPORTING AND STORING

A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28-day compressive strength and a period of at least 5 days has elapsed since casting, unless otherwise permitted by the Engineer.

B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.

C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.

D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.

E. Precast concrete members shall not be used as storage areas for other materials or equipment.

F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

3.03 ERECTION

A. Erection shall be carried out by the manufacturer or under his supervision using labor, equipment, tools, and materials required for proper execution of the work.

B. Contractor shall prepare all bearing surfaces to a true and level line prior to erection. All supports of the precast members shall be accurately located and of required size and bearing materials.

C. Installation of the precast members shall be made by leveling the top surface of the assembled units keeping the units tight and at right angles to the bearing surface.

D. Connections which require welding shall be properly made in accordance with Section 05 05 23 – Metal Fastening.

E. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.

F. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).

G. No Contractor, Subcontractor or any of his employees shall arbitrarily cut, drill, punch or otherwise tamper with the precast members.

H. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

END OF SECTION

SECTION 03 60 00
GROUT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. CRD-C 621 – Corps of Engineers Specification for Non-shrink Grout

2. ASTM C 33 – Standard Specification for Concrete Aggregates

3. ASTM C 109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens)

4. ASTM C 531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacings

5. ASTM C 579 – Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacings

6. ASTM C 827 – Standard Test Method for Early Volume Change of Cementitious Mixtures

7. ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein.

2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

1.05 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.

    a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.

    b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.

2. The cost for obtaining samples for testing,, specimen preparation, curing, transportation and laboratory tests on grout will be borne by the Contractor. The Contractor shall be responsible for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens, at no additional cost to the Owner.

3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall

consist of one part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

2. The minimum compressive strength at 28 days shall be 4000 psi.

3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.

4. Sand shall conform to the requirements of ASTM C33.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "Euco N-S" by the Euclid Chemical Company, "Sikagrout 212" by Sika Corporation, “Conspec 100 Non-Shrink Non-Metallic Grout” by Conspec, “Masterflow 555 Grout” by BASF Master Builder Solutions.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "Euco #452 Series" by Euclid Chemical, “MasterEmaco ADH 1090 RS” by BASF Master Builder Solutions.

2. Epoxy grout shall be modified as required for each particular application with aggregate per manufacturer's instructions.

2.02 CURING MATERIALS

A. Curing materials shall be as specified in Section 03 39 00, Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts.

PART 3 – EXECUTION

3.01 GENERAL

A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.

1. Cement grout shall be used for grout toppings and for patching of fresh concrete.

2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.

3. Epoxy grout shall be used for bonding new concrete to hardened concrete.

B. New concrete surfaces to receive cement grout shall be as specified in Section 03 35 00, Concrete Finishes, and shall be cleaned of all dirt, grease and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03 39 00, Concrete Curing.

C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

D. The Contractor, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the Owner.

3.02 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.

3.03 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

3.04 GROUT INSTALLATION

A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, grout shall be poured from one side only and thence flow across to the open side to avoid air-entrapment.

END OF SECTION

SECTION 05 05 13
GALVANIZING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Where galvanizing is called for in the Contract Documents, the galvanizing shall be performed in accordance with the provisions of this Section unless otherwise noted.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Further requirements for galvanizing specific items may be included in other Sections of the Specifications. See section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. International Building Code

2. ASTM A123 – Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip

3. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ASTM A653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

5. ASTM A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

6. ASTM A780 – Standard Practice of Repair of Damaged Hot-Dip Galvanized Coatings

7. ASTM F2329 – Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

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1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Certification that the item(s) are galvanized in accordance with the applicable ASTM standards specified herein. This certification may be included as part of any material certification that may be required by other Sections of the Specifications.

PART 2 – PRODUCTS

2.01 GALVANIC COATING

A. Material composition of the galvanic coating shall be in accordance with the applicable ASTM standards specified herein.

PART 3 – EXECUTION

3.01 FABRICATED PRODUCTS

A. Products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strips, 1/8 inch thick and heavier which are to be galvanized shall be galvanized in accordance with ASTM A123. Products shall be fabricated into the largest unit which is practicable to galvanize before the galvanizing is done. Fabrication shall include all operations necessary to complete the unit such as shearing, cutting, punching, forming, drilling, milling, bending, and welding. Components of bolted or riveted assemblies shall be galvanized separately before assembly. When it is necessary to straighten any sections after galvanizing, such work shall be performed without damage to the zinc coating. The galvanizer shall be a member of American Galvanizers Association.

B. Components with partial surface finishes shall be commercial blast cleaned prior to pickling.

C. Sampling and testing of each lot shall be performed prior to shipment from the galvanizer's facility per ASTM A123.

3.02 HARDWARE

A. Iron and steel hardware which is to be galvanized shall be galvanized in accordance with ASTM A153 and ASTM F2329.

3.03 ASSEMBLED PRODUCTS

A. Assembled steel products which are to be galvanized shall be galvanized in accordance with ASTM A123. All edges of tightly contacting surfaces shall be completely sealed by welding before galvanizing.

B. Assemblies shall be provided with vent and drain holes as required by the fabricator. Vent and drain hole sizes and locations shall be included in the structural steel shop drawings required in Section 05 12 00 – Structural Steel for approval. All vent and drain holes shall be plugged and finished to be flush with and blend in with the surrounding

surface. Where water intrusion can occur, the plug shall be carefully melted into the surrounding zinc coating using an appropriate fluxing agent.

3.04 METAL DECK

A. Unless noted otherwise, metal deck shall be galvanized in accordance with ASTM A653 G60 minimum. In moist environments or as indicated on the Contract Drawings, galvanizing shall meet the requirements of ASTM A653 G90.

B. Galvanized metal deck shall meet the requirements of ASTM A924.

3.05 REPAIR OF GALVANIZING

A. Galvanized surfaces that are abraded or damaged at any time after the application of zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with 2 coats of zinc rich paint meeting the requirements of Federal Specification DOD-P-21035A and shall be thoroughly mixed prior to application. Zinc rich paint shall not be tinted. The total thickness of the 2 coats shall not be less than 6 mils. In lieu of repairing by painting with zinc rich paint, other methods of repairing galvanized surfaces in accordance with ASTM A780 may be used provided the proposed method is acceptable to the Engineer.

END OF SECTION

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SECTION 05 05 23
METAL FASTENING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 14 00 – Structural Aluminum

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. International Building Code
2. AC 193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements
3. AC 308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
4. ACI 318 – Building Code Requirements for Structural Concrete
5. ACI 355.2 – Qualifications of Post-Installed Mechanical Anchors in Concrete
6. ACI 355.4 – Qualifications of Post-Installed Adhesive Anchors in Concrete
7. AISC 348 – The 2009 RCSC Specification for Structural Joints
8. AISC – Code of Standard Practice
9. AWS D1.1 – Structural Welding Code – Steel
10. AWS D1.2 – Structural Welding Code – Aluminum
11. AWS D1.6 – Structural Welding Code – Stainless Steel
12. Aluminum Association – Specifications for Aluminum Structures

13. ASTM A572/A572M-94C – Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50

14. ASTM A36 – Standard Specification for Carbon Structural Steel

15. ASTM A489 – Standard Specification for Eyebolts

16. ASTM A563 – Standard Specifications for Carbon and Alloy Steel Nuts

17. ASTM D1785 – Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe

18. ASTM E488 – Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

19. ASTM F436 – Standard Specification for Hardened Steel Washers

20. ASTM F467 – Standard Specification for Nonferrous Nuts for General Use

21. ASTM F593 – Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs

22. ASTM F594 – Standard Specification for Stainless Steel Nuts

23. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

24. ASTM F3125 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch and Metric Dimension

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.

2. Anchor design calculations sealed by a Professional Engineer currently registered in the State of Georgia. Only required if design not shown on Contract Drawings.

3. A current Evaluation Report shall be submitted for all anchors that will be considered for use on this project.

4. Manufacturer’s installation instructions.

5. Copy of valid certification for each person who is to perform field welding.

6. Certified weld inspection reports, when required.

7. Welding procedures.

8. Installer qualifications.

9. Certification of Installer Training.

10. Inspection Reports.

11. Results of Anchor Proof Testing.

1.05 QUALITY ASSURANCE

A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.

B. Evaluation Report: A current Evaluation Report from an independent testing and evaluation agency (ITEA) shall be submitted for all anchors that will be used on this project. The ITEA producing the evaluation report shall be accredited in accordance with the requirements for ITEA's in ACI 355.2 (for mechanical anchors) or 355.4 (for adhesive anchors). Acceptable ITEA's include but are not necessarily limited to the International Code Council Evaluation Service (ICC-ES) and the International Association of Plumbing and Mechanical Officials Uniform Evaluation Service (IAPMO-UES).

C. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

D. Installer Training: For concrete anchors, conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:

1. Hole drilling procedure.

2. Hole preparation and cleaning technique.

3. Adhesive injection technique and dispenser training/maintenance.

4. Concrete adhesive anchor preparation and installation.

5. Proof loading/torquing.

6. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information

7. Provide a copy of the current ACI/CRSI “Adhesive Anchor Installer” certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.

E. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.

F. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.

G. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.

H. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

I. Inspections of the adhesive dowel system shall be made by the Contractor in the presence of the Engineer or other representatives of the Owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injections, installation, and proof testing.

PART 2 – PRODUCTS

2.01 ANCHOR RODS (ANCHOR BOLTS)

A. Anchor rods shall conform to ASTM F1554 Grade 55 except where stainless steel or other approved anchor rods are shown on the Drawings. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A.

B. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip galvanized in accordance with ASTM F1554.

C. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.02 HIGH STRENGTH BOLTS

A. High strength bolts and associated nuts and washers shall be in accordance with ASTM F3125. Bolts, nuts and washers shall meet the requirements of RCSC Specification for Structural Joints Using High Strength Bolts".

B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

A. Stainless steel bolts shall conform to ASTM F-593 Grade A325 or F1852. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.

B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

2.04 CONCRETE ANCHORS

A. General

1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by an approved independent testing laboratory. There are two types used:

    a. Mechanical anchors include any of the following anchors:

        1) Expansion anchors shall be mechanical anchors of the wedge, sleeve, or drop-in type that are set by expanding against the sides of the drilled hole.

        2) ii. Screw anchors are mechanical anchors that derive tensile holding strength by the mechanical interlock provided by threads cutting into the concrete during installation. Screw anchors shall be one piece, heavy duty screw anchors with a finished head.

    b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.

2. Expansion anchors shall not be used to hang items from above or in any other situations where direct tension forces are induced in anchor.

3. Unless otherwise noted, all concrete anchors which are submerged or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors.

4. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193. Anchors in Seismic Design Categories C through F shall conform to the International Building Code and ACI 318 Appendix D requirements as applicable, including seismic test requirements.

5. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.

6. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Concrete Anchor Design:

An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, it shall be considered an engineered design and anchors shall be installed to the prescribed size, spacing, embedment depth and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the anchors will be considered an engineered design and the Contractor shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the Engineer. Where an anchor design is not indicated by the Engineer on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.

a. The Contractor shall submit an engineered design with signed and sealed calculations performed by an Engineer currently registered in the State of Georgia. Anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 Appendix D.

b. Embedment Depth

1) Minimum anchor embedment shall be as indicated on the Drawings or determined by the Contractor's engineered design. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on ""Pure 110+ by DeWalt" ESR 3298

issued 7/2017. If the contractor submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2) Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer's standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).

3) The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer's literature.

C. Anchors:

1. Mechanical Anchors:

a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "TruBolt +" by ITW Redhead, "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Power-Stud+SD1" or "Power-Stud+ SD-2" by DeWalt.

b. Screw Anchors: Screw anchors shall be "Kwik HUS-EZ" and "KWIK HUS-EZ-I" by Hilti, Inc., "Titen HD" by Simpson Strong-Tie Co., or "Screw-Bolt+" by DeWalt. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.

c. Sleeve Anchors: Sleeve anchors shall be "HSL-3 Heavy Duty Sleeve Anchor" by Hilti, Inc. or "Power-Bolt +" by DeWalt.

d. Shallow Embedment Internally Threaded Insert (3/4" max embedment): "Mini-Undercut +Anchor" by DeWalt, "HSC-A" by Hilti, Inc. or approved equal.

e. Mechanical anchor systems shall comply with ACI 355.2 or alternatively the latest revision of AC 193, and shall have a valid evaluation report in accordance with the applicable building code.

2. Adhesive Anchors:

a. Adhesive anchors shall be "Epcon C6+ Adhesive Anchoring System" by ITW Redhead, "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "SET-3G

Epoxy Adhesive Anchors" by Simpson Strong-Tie Co., or "Pure 110+ Epoxy Adhesive Anchor System" by DeWalt.

b. Adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Adhesive anchor systems shall comply with ACI 355.4 or alternatively the latest revision of AC308, and shall have a valid evaluation report in accordance with the applicable building code. **No or equal products will be considered unless prequalified and approved by the Engineer and Owner**.

D. Concrete Anchor Materials:

1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.

2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.

3. Nuts, washers, and other hardware shall be of a material to match the anchors.

2.05 MASONRY ANCHORS

A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.

B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust prior to installation of adhesive and anchor. Contractor shall follow manufacturer's installation instructions. The adhesive system shall be "HIT HY-70 System" as manufactured by Hilti, Inc., or "AC100+ Acrylic Adhesive" by DeWalt, "SET-XP" as manufactured by Simpson Strong-Tie Co.

C. Masonry anchors used to anchor steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, masonry anchors shall also be galvanized.

D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater anchors shall be Type 316 stainless steel.

E. Although all manufacturers listed are permitted, the masonry anchor design is based on “SET-XP by Simpson Strong-Tie ER 265 Revised 1-31-2017. the contractor submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the proposed product and the Contractor shall provide the conditions stipulated by the Engineer specific to the approved adhesive anchor.

2.06 WELDS

A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).

B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.

C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.07 WELDED STUD CONNECTORS

A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.08 EYEBOLTS

A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.09 HASTELLOY FASTENERS

A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.10 ANTISEIZE LUBRICANT

A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 – EXECUTION

3.01 MEASUREMENTS

A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 ANCHOR INSTALLATION

A. Anchor Rods, Concrete Anchors, and Masonry Anchors

1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.

2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.

3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.

4. All stainless steel threads shall be coated with antiseize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

C. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and shall be at least 50 degrees F.

2. Concrete Anchor Testing:

a. At all locations, at least 25 percent of all concrete anchors installed shall be proof tested to the value indicated on the Drawings, with a minimum of one tested anchor per anchor group. If no test value is indicated on the Drawings, the Contractor shall notify the Engineer to allow verification of whether anchor load proof testing is required.

b. Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E488 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.

c. Where Contract Documents indicate anchorage design to be the Contractor's responsibility, the Contractor shall submit a plan and schedule

indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the State of Georgia. The Contractor's Engineer shall also submit documentation indicating the Contractor's proof testing procedures have been reviewed and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E488.

d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.

e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.

3. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.

4. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. . Injection of adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.

5. All adhesive anchor installations in the horizontal to vertically overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-11 D.9.2.2. Current AAI Certificate must be submitted to the Engineer of Record prior to commencement of any adhesive anchor installations.

D. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal.

2. All stainless steel bolts shall be coated with antiseize lubricant.

3.03 WELDING

A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.

B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.04 INSPECTION

A. High strength bolting will be visually inspected in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Rejected bolts shall be either replaced or retightened as required.

B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.

C. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

END OF SECTION

SECTION 05 10 00
METAL MATERIALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Materials for fasteners are included in Section 05 05 23 – Metal Fastening.

B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM A36 – Standard Specification for Structural Steel

B. ASTM A47 – Standard Specification for Malleable Iron Castings

C. ASTM A48 – Standard Specification for Gray Iron Castings

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

E. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

F. ASTM A276 – Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes

G. ASTM A307 – Standard Specification for Carbon Steel Externally Threaded Standard Fasteners

H. ASTM A446 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality

I. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

J. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

K. ASTM A529 – Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)

L. ASTM A536 – Standard Specification for Ductile Iron Castings

M. ASTM A570 – Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality

N. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

O. ASTM A992 – Standard Specification for Structural Steel Shapes

P. ASTM A666 – Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications

Q. ASTM A1085 – Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)

R. ASTM B26 – Standard Specification for Aluminum-Alloy Sand Castings

S. ASTM B85 – Standard Specification for Aluminum-Alloy Die Castings

T. ASTM B108 – Standard Specification for Aluminum-Alloy Permanent Mold Castings

U. ASTM B138 – Standard Specification for Manganese Bronze Rod, Bar, and Shapes

V. ASTM B209 – Standard Specification for Aluminum-Alloy Sheet and Plate

W. ASTM B221 – Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

X. ASTM B308 – Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded

Y. ASTM B574 – Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod

Z. ASTM F468 - Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

AA. ASTM F593 – Standard Specification for Stainless Steel Fasteners

1.04 SUBMITTALS

A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing materials, the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

PART 2 – PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

A. Material types and ASTM designations shall be as listed below:

Steel W Shapes	A992
Steel HP Shapes	A572 Grade 50
Steel M, S, C,and MC shapes and Angles, Bars, and Plates	A36
Rods	F 1554 Grade 36
Pipe - Structural Use	A53 Grade B
Hollow Structural Sections	A500 Grade C or A1085
Cold-Formed Steel Framing	A 653

2.02 STAINLESS STEEL

A. All stainless steel fabrications exposed to underwater service shall be Type 316. All other stainless steel fabrications shall be Type 304, unless noted otherwise.

B. Material types and ASTM designations are listed below:

Plates and Sheets	ASTM A167 or A666 Grade A
Structural Shapes	ASTM A276
Fasteners (Bolts, etc.)	ASTM F593

2.03 ALUMINUM

A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed below:

Structural Shapes	ASTM B308
Castings	ASTM B26, B85, or B108
Extruded Bars	ASTM B221 - Alloy 6061
Extruded Rods, Shapes and Tubes	ASTM B221 - Alloy 6063
Plates	ASTM B209 - Alloy 6061
Sheets	ASTM B221 - Alloy 3003

C. All aluminum structural members shall conform to the requirements of Section 05 14 00 – Structural Aluminum.

D. All aluminum shall be provided with mill finish unless otherwise noted.

E. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts in accordance with Section 05 05 23 – Metal Fastening.

2.04 CAST IRON

A. Material types and ASTM designations are listed below:

Gray	ASTM A48 Class 30B
Malleable	ASTM A47
Ductile	ASTM A536 Grade 60-40-18

2.05 BRONZE

A. Material types and ASTM designations are listed below:

Rods, Bars and Sheets	ASTM B138 - Alloy B Soft

2.06 HASTELLOY

A. All Hastelloy shall be Alloy C-276.

2.07 DISSIMILAR METALS

A. Dielectric isolation shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			●	●	●	●	●	●	●
Galvanized Steel			●	●	●	●	●	●	●
Aluminum	●	●		●	●	●	●	●	●
Cast Iron	●	●	●				●	●	●
Ductile Iron	●	●	●				●	●	●
Mild Steel/ Carbon Steel	●	●	●				●	●	●
Copper	●	●	●	●	●	●			●
Brass	●	●	●	●	●	●			●
Stainless Steel	●	●	●	●	●	●	●	●	

1. "●" signifies dielectric isolation is required between the two materials noted.
2. Consult Engineer for items not listed in table.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 05 12 00
STRUCTURAL STEEL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural steel work in accordance with the Contract Documents. The term "structural steel" shall include items as defined in the AISC "Code of Standard Practice".

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 13 – Galvanizing

C. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. International Building Code

2. AISC – "Code of Standard Practice"

3. AISC – "Specification for Structural Steel Buildings"

4. AISC – RCSC “Specification for Structural Joints Using High Strength Bolts”

5. AWS – "Structural Welding Code"

6. ASTM A786 – Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Certified Mill Test Reports

2. Affidavit of Compliance with grade specified

3. Shop Drawings which include the following:

a. Layout drawings indicating all structural shapes, sizes, and dimensions.

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b. Beam and column schedules.

c. Detailed drawings indicating jointing, anchoring and connection details and vent and drain holes where required.

1.05 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at the Owner's expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from the responsibility for furnishing proper materials or workmanship under this Specification.

B. The structural steel erector shall be a qualified installer who participates in the AISC Certification program and is designated an AISC Certified Erector.

C. The structural steel fabricator shall be a qualified fabricator who participates in the AISC Certification program and is designated an AISC Certified Building Fabricator.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Structural Steel

1. Structural steel for W, C, and MC shapes shall conform to ASTM A992 unless otherwise indicated.

2. Structural steel for HP shapes shall conform to ASTM A572 Grade 50 unless otherwise indicated.

3. Structural steel for S and M shapes and angles and plates shall conform to ASTM A36 unless otherwise indicated.

4. Steel pipe shall be ASTM A53, Grade B.

5. HSS shall be ASTM A500, Grade C or ASTM A1085. All members shall be furnished full length without splices unless otherwise noted or accepted by the Engineer.

6. All unidentified steel will be rejected and shall be removed from the site and replaced by the Contractor, all at the expense of the Contractor.

7. Fasteners for structural steel shall be in accordance with Section 05 05 23 – Metal Fastening.

B. Welds

1. Electrodes for welding shall be in accordance with Section 05 05 23 – Metal Fastening.

PART 3 – EXECUTION

3.01 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

A. Fabrication shall be in accordance with the AISC "Specification for Structural Steel Buildings and AISC "Code of Standard Practice". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural steel members required for anchors, anchor rods, bolts, sag rods, vent and drain holes or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

E. Where galvanizing of structural steel is required, galvanizing shall be done in accordance with Section 05 05 13 – Galvanizing.

F. Checkered floor plate shall meet the requirements of ASTM A786.

3.03 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

A. The erection of all structural steel shall conform to the applicable requirements of the AISC "Specification for Structural Steel Buildings" and AISC "Code of Standard Practice". All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastened.

C. No cutting of structural steel members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05 05 23 – Metal Fastening.

F. All bolted connections shall use high strength bolts in accordance with Section 05 05 23 – Metal Fastening. High strength bolts shall be installed in accordance with RCSC “Specification for Structural Joints Using High Strength Bolts”. Bolts specified or noted on the Drawings to be a tension or slip critical “SC” type connection shall be fully pretensioned with proper preparation of the faying surfaces. All other bolts shall be snug tightened unless otherwise noted on the Drawings.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections

1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.

3. Where misalignment between anchor rods and rod holes in steel members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.

2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03 60 00 – Grout.

4. Anchor rods shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

A. Painting shall be performed according to Section 09 90 00 – Painting and the following additional requirements.

1. Concrete Encased Steel: Steel members which will be encased in concrete shall be cleaned but not painted prior to encasement.

2. Contact Surfaces: Contact surfaces such as at field connections, shall be cleaned and primed but not painted.

3. Finished Surfaces: Machine finished surfaces shall be protected against corrosion by a rust-inhibiting coating which is easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

4. Surfaces Adjacent to Field Welds: Surfaces within 2 inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

END OF SECTION

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SECTION 05 14 00
STRUCTURAL ALUMINUM

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural aluminum work in accordance with the Contract Documents. The term "structural aluminum" shall include items as defined in the Aluminum Association "Specifications for Aluminum Structures".

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Section 09 90 00 – Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of the Bid.

1. International Building Code

2. Aluminum Association "Specifications for Aluminum Structures"

3. AWS D1.2 – "Structural Welding Code"

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Certified Mill Test Reports

2. Affidavit of Compliance with grade specified

3. Shop Drawings which include the following:

a. Layout drawings indicating all structural shapes, sizes, and dimensions.

b. Beam and column schedules.

c. Detailed drawings indicating jointing, anchoring and connection details.

1.05 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at his own expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Structural aluminum shall comply with Section 05 10 00 – Metal Materials.

B. Fasteners for structural aluminum shall be in accordance with Section 05 05 23 – Metal Fastening.

C. Electrodes for welding shall be in accordance with Section 05 05 23 – Metal Fastening.

PART 3 – EXECUTION

3.01 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

A. Fabrication shall be in accordance with the Aluminum Association "Specifications for Aluminum Structures". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural aluminum members required for anchors, anchor rods, bolts, or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

3.03 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural aluminum members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

A. All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened. A licensed civil engineer shall survey the structural aluminum during erection and shall provide a final survey indicating elevations and locations of all major members. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

C. No cutting of structural aluminum members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05 05 23 – Metal Fastening.

F. All bolted connections shall comply with Section 05 05 23 – Metal Fastening.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections

1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.

3. Where misalignment between anchor bolts and bolt holes in aluminum members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.

2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03 60 00 – Grout.

4. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

A. Painting shall be performed according to Section 09 90 00 – Painting.

B. Aluminum surfaces in contact with concrete or dissimilar metals shall be thoroughly protected with two coats of epoxy paint with a minimum total thickness of 16 mils or other approved isolating material in accordance with the requirements of Section 09 90 00 – Painting.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 – GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal fabrications not specifically included in other Sections, complete and in accordance with the requirements of the Contract Documents.

B. Work shall include but may not be limited to guard posts.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Certain specific items are included in other Sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. International Building Code

2. AISC – Specification for Structural Steel Buildings

3. AISI – Specifications for the Design of Cold-Formed Steel Structural Members

4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used in metal fabrications shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in metal fabrication shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 GUARD POSTS (BOLLARDS)

A. Guard posts shall be 6-inch diameter Schedule 40 galvanized steel pipe in accordance with ASTM A53.

B. Guard posts shall be concrete filled and crowned, as detailed in the Drawings.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metal work shall be field painted when as specified in accordance with Section 09 90 00 – Painting.

END OF SECTION

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SECTION 05 51 00
METAL STAIRS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal stairs in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Section 05 14 00 – Structural Aluminum

D. Section 05 52 00 – Guards and Railings

E. Section 05 55 00 – Stair Treads and Nosings

F. Section 05 53 00 – Gratings

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. International Building Code

2. AISC – Specification for Structural Steel Buildings

3. AISI – Specification for the Design of Cold-Formed Steel Structural Members

4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all metal work specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for metal stairs shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds, bolts, and fasteners used in metal stairs shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 METAL STAIRS AND LANDINGS

A. Stair stringers and structural framing of landings shall be fabricated from steel or aluminum as indicated on the Drawings.

   1. Aluminum stairs shall be fabricated from aluminum alloy 6061-T6 in accordance with Section 05 14 00 – Structural Aluminum.

B. Regardless of material of stringers, all stair treads shall be aluminum in accordance with Section 05 55 00 – Stair Treads and Nosings.

C. Where metal landings are required as indicated on the Drawings, gratings at landings shall conform to Section 05 53 00 – Gratings.

D. Handrails for metal stairs shall conform to Section 05 52 00 – Handrails and Railings. Contractor shall coordinate attachment of handrails to metal stairs.

E. All clips, anchors, and necessary appurtenances shall be provided for a complete and rigid installation.

F. Closure plates shall be provided for all exposed ends of stringers.

G. All exposed connections shall be welded and ground smooth, unless otherwise indicated on the Drawings.

H. Stairs and landings shall be designed to support a 100 psf live load, minimum, unless otherwise indicated on the Drawings.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of metal stairs shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metal stairs shall field painted when specified in accordance with Section 09 90 00 – Painting.

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SECTION 05 51 33
LADDERS

PART 1 – GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all ladders in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. International Building Code

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for ladders shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for ladders shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 LADDERS

A. Ladders shall be furnished with all mounting brackets, baseplates, fasteners, and necessary appurtenances for a complete and rigid installation.

B. All ladders shall be aluminum alloy 6061-T6 or 6063-T5, with a clear, anodized finish, Aluminum Association M12C22A41.

C. All ladders shall conform to dimensions indicated on the Drawings and shall comply with OSHA requirements.

D. Side rails shall be 1-1/2 inch diameter Schedule 80 pipe, minimum.

E. Rungs shall be serrated 3/4 inch diameter, minimum.

F. All exposed connections shall be welded and ground smooth.

G. Ladders shall be as manufactured by Thompson Fabricating Company, or equal.

2.04 LADDER SAFETY SYSTEM

A. All ladders with an uninterrupted length exceeding 15 ft. between landings or floors shall be installed with a ladder safety system.

B. Ladder safety system shall comply with OSHA requirements and meet ANSI A14.3 requirements.

C. Ladder safety system shall include all necessary components to provide a fully operational system, including one full body safety harness with a 310 lb. weight capacity for each ladder safety system.

D. Ladder Safety Systems shall be submitted to Engineer for approval.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metalwork shall be field painted when specified in accordance with Section 09 90 00 – Painting.

END OF SECTION

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SECTION 05 52 00
GUARDS AND RAILINGS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all handrails and railings in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. International Building Code

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all metal work specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for handrails and railings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in handrails and railings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 HANDRAILS AND RAILINGS

A. General - Handrail systems shall consist of all railings, posts, toeboards, baseplates, anchors, and accessories required for a complete and rigid installation.

1. All handrail systems shall be fabricated from extruded aluminum alloy 6061-T6 or 6105-T5, with Aluminum Association M12C22A41 finish, unless otherwise noted.

2. Metal railings shall be fabricated from 1-1/2 inch Schedule 40 pipe. Metal railing support posts shall be fabricated from 1-1/2 inch Schedule 80 pipe.

3. The centerline of the top guard rail shall be 42 inches above the walking surface for level rail. For stair rail, the centerline of the top guard rail shall be 42 inches above the leading edge of the tread nosing. Stair handrail shall be 34 inches above the leading edge of the tread nosing.

4. Posts

    a. Maximum horizontal spacing between posts for level rail shall be six feet.

    b. Maximum horizontal spacing between posts for stair rail shall be five feet.

5. All rail joints shall be finished flush and shall occur only at supports. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations. The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings.

6. Toeboards

    a. Toeboards shall project 4-inches above the walking surface and shall not infringe on the minimum required walkway width.

    b. Aluminum toeboards shall be extruded from aluminum alloy 6063-T6 unless otherwise noted.

    c. Toeboards shall have a minimum thickness of 1/8" at any point. Geometry of toeboard shall closely resemble geometry shown on Drawings.

7. Expansion joint splices shall be provided at 30 foot maximum spacing and at all expansion joints in the structure supporting the handrail.

8. The handrail system shall be designed to resist the design loads specified by both OSHA and the International Building Code.

9. Provide handrail extensions at top and bottom of stairs and ramps in accordance with the International Building Code.

B. For metal handrail, the Contractor shall have the option of providing a handrail system of either an all welded type construction or a component type construction.

1. With both the all welded or component type construction, the baseplates and toeboards shall be furnished as shown on the Drawings.

2. Component Type System

a. All fittings and brackets shall be designed for stainless steel concealed set screws with internal tyne type connectors.

b. Exposed fittings shall be cast or extruded aluminum, or stainless steel to match ladder material, except where corrosion-resistant steel is employed as a standard fabricator's item for use.

c. Component type handrail shall be as manufactured by Thompson Fabricating Company, Inc., or Hollaender Manufacturing Company, Inc.

3. Welded handrail may be field assembled using component type fittings as described herein.

C. Handrail shall be Type I handrail as shown on the Drawings.

1. Type I handrail shall be a two-rail system. The centerline of the intermediate rail shall be 21 inches above the walking surface.

D. Where gates are required in handrails as shown on the Drawings, they shall be self-closing and shall be provided by the same manufacturer as the handrail. Gates shall swing away from the opening being protected by the handrail.

E. Where safety chains are required in handrails as shown on the Drawings, chains shall be constructed of Type 304 stainless steel. Chains shall be straight link style, 3/16-inch diameter, with at least twelve links per foot, and with snap hooks on each end. Snap hooks shall be boat type and eye bolts for attachment of chains shall be 3/8-inch bolts with 3/4-inch eye diameter welded to the railing posts. Two (2) chains, four inches longer than the anchorage spacing shall be supplied for each guarded area.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. Concrete anchors and bolts for attachment of handrail baseplates to supporting members shall conform to Section 05 05 23 – Metal Fastening.

G. All fabricated items shall be shop painted in accordance with Section 09 90 00 – Painting.

3.02 INSTALLATION

A. Assembly and installation of handrails and railings shall be performed in strict accordance with manufacturer's recommendations.

B. All handrails and railings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

END OF SECTION

SECTION 05 53 00
GRATINGS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all gratings, floor plates, and access doors in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. International Building Code

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection Drawings of all gratings, floor plates, and access doors specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for gratings, floor plates, and access doors shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for gratings, floor plates, and access doors shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 GRATING

A. General - Grating, including support frames, fastenings, and all necessary appurtenances for a complete installation, shall be furnished as indicated on the Drawings. All grating shall be made of non-slip materials in both directions.

1. All exposed bearing ends of grating shall be enclosed in a perimeter band of the same dimensions and material as the main bars, including ends at all cutouts.

2. Grating shall be fabricated into easily removable sections and shall be fastened at each corner and as required with fasteners provided by the grating manufacturer. No fasteners shall be permitted to project above the walking surface.

3. Grating shall be designed for a loading of 150 psf unless otherwise required by the Drawings. Grating deflection shall not exceed 1/4 inch under a uniform load of 100 psf. Minimum grating depth shall be 1-1/2 inches, unless structural requirements based on clear span require more depth.

4. Grating installed in cast-in-place concrete shall be provided with embedded support frames on all perimeter and bearing edges. Support frames shall include anchor straps or headed studs at a maximum of 18” on-center, a minimum of two each side. Support frames shall be fabricated from the same material as the grating.

B. Aluminum Grating

1. Aluminum grating shall be of I-bar type and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Plank clips for grating holddowns or other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.

2. Grating shall be “19-SI-4 I-Bar Swage Locked” by Alabama Metal Industries Corporation (AMICO), “IB” by Harsco Industrial IKG, “I-Bar 19SGI4", by Ohio Grating Inc., or “I-Bar” by Thompson Fabricating LLC.

C. Galvanized Steel Grating

1. Steel grating and hardware shall be hot dipped galvanized per ASTM A123 and ASTM F2329.

2. Steel grating shall have a skid resistant serrated top surface.

3. Steel grating shall be manufactured by Harsco Industrial IKG and Ohio Gratings, Inc.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All gratings, checkered floor plates, and access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions. Embedded support frames shall be set level and square.

C. Grating shall not be field cut or modified unless approved by Engineer.

D. Grating shall not be used for equipment support or anchorage.

END OF SECTION

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SECTION 05 55 00
STAIR TREADS AND NOSINGS

PART 1 – GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all stair treads and nosings in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Section 05 51 00 – Metal Stairs

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. International Building Code

2. Aluminum Association Specifications for Aluminum Structures.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all work specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for stair treads and nosings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for stair treads and nosings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 SAFETY STAIR NOSINGS

A. Abrasive cast aluminum, safety stair nosings shall be provided on all concrete or concrete filled steel pan stairs, including the top stair of metal stairs that attach to concrete, and as shown on the Drawings unless noted otherwise.

B. Nosing shall be 3 inches wide and shall extend the full width of the stairway minus 3 inches on either side. Nosing shall be cast into the concrete and held in place with butterfly type extruded anchors.

C. The nosing shall be "Style 231-A", by Amstep Products, “Alumogrit Type 101", by Wooster Products, Inc., "Type AX", by Safe-T-Metal Company. For steel pan concrete filled stairs, nosing shall be "Type 101-SP", Wooster Products, Inc., or "Type AXPE", by Safe-T-Metal Company. For pan stairs, nosing shall be continuous over corner of stair treads to fully protect corner of treads from abrasion. All exposed fasteners shall be Type 304 stainless steel.

2.04 STAIR TREADS

A. Stair treads shall be aluminum with an abrasive nosing as shown on the Drawings.

B. Stair treads shall be designed for the live load specified in Section 05 51 00 – Metal Stairs.

C. Stair treads shall be as manufactured by IKG Industries, or Safe-T-Metal Company.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

E. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

A. Assembly and installation of stair treads and nosings shall be performed in strict accordance with manufacturer's recommendations.

B. All stair treads and nosings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

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SECTION 05 56 00
CASTINGS

PART 1 – GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all castings in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 33 05 61 – Utility Structures

B. Section 05 10 00 – Metal Materials

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. International Building Code – 2000

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all castings specified herein.

2. Other submittals as required in accordance with Section 05 10 00 – Metal Materials and Section 05 05 23 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for castings shall conform to Section 05 10 00 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for castings shall conform to Section 05 05 23 – Metal Fastening, unless noted otherwise.

2.03 IRON CASTINGS

A. General - Iron Castings shall include, but not be limited to frames, covers, and grates for trench drains, catch basins, and inlets/.

1. Castings shall be of gray iron of uniform quality, free from defects, smooth and well cleaned by shotblasting.

2. Catalog numbers on the Drawings are provided only to show required types and configuration. All covers shall be cast with raised letters as designated on the Drawings.

3. Castings shall be as manufactured by Dewey Brothers, or Neenah Foundry Company.

B. Covers and Grates

1. Covers and grates shall be provided with matching frames. Cover shall fit flush with the surrounding finished surface. The cover shall not rock or rattle when loading is applied.

2. Round covers and frames shall have machined bearing surfaces.

3. Design loadings:

a. Where located within a structure, a minimum design loading of 300 psf shall be used, unless noted otherwise.

b. At all locations not within a structure, the design loading shall be a standard AASHTO H-20 truck loading, unless otherwise noted.

C. Watertight gasketing, bolting, locking devices, patterns, lettering, pickholes, vents, or self-sealing features shall be as detailed on the Drawings.

PART 3 – EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All castings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

END OF SECTION

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SECTION 05 59 00
BEARING DEVICES AND ANCHORING

PART 1 – GENERAL

1.01 THE REQUIREMENTS

A. The Contractor shall furnish and install bearing plates, pads, expansion devices, anchor rods and bolts and/or other devices used in conjunction with bearings and anchoring of bearing devices and assemblies at supports in accordance with this item and in conformity with the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 10 00 – Metal Materials

B. Section 05 05 23 – Metal Fastening

C. Section 05 14 00 – Structural Aluminum

D. Section 09 90 00 – Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified hereunder shall conform to the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

1. RMA Rubber Handbook – A4-F3-T.063-B2, Grade 2, Method B

2. ASTM A240 – Standard Specification for Heat Resisting Chromium and Chromium – Nickel Stainless Steel Plate and Sheet

3. ASTM A480 – Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip

4. ASTM D395 Method B – Standard Test for Rubber Property – Compression Set

5. ASTM D412 – Standard Test for Rubber Properties In Tension

6. ASTM D471 – Standard Test for Rubber Property – Effect of Liquids

7. ASTM D573 – Standard Test for Rubber-Deterioration In Air Oven

8. ASTM D575, Method A – Standard Test for Rubber Properties In Compression

9. ASTM D624, Die C – Standard Test for Rubber Property – Tear Resistance

10. ASTM D746 – Standard Test for Brittleness Temperature of Plastics and Elastomers by Impact

11. ASTM D792 – Standard Test for Specific Gravity and Density of Plastics by Displacement

12. ASTM D1149 – Standard Test for Rubber Deterioration – Surface Ozone Cracking in a Chamber (Flat Specimens)

13. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40

14. ASTM D2240 – Standard Test for Rubber Property – Durometer Hardness

15. ASTM D2256 – Standard Test for Breaking Load (Strength) and Elongation of Yarn by the Single-Strand Method

16. ASTM D4894 – Standard Specification for PTFE Granular Molding and RPM Extension Materials

17. ASTM D4895 – Standard Specification for PTFE Resin Produced from Dispersion

1.04 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01 33 00 – Submittal Procedures:

1. Certification of compliance that the materials furnished under this section meet and conform to the property and physical requirements, including all testing, as stated herein and as referenced. Specifically, the certification shall state compliance with the applicable standards (ASTM, ANSI, etc.) for fabrication and testing.

2. Shop Drawings for all materials, including installation and adjustment instructions. Included with the Shop Drawings shall be all material certifications, mill test results, working drawings, etc., which are required by this and other applicable sections of the Specifications.

PART 2 – PRODUCTS

2.01 ELASTOMERIC BEARING PADS

A. The elastomer portion of pads shall be new neoprene compound. Pads shall be cast under heat and pressure and may be individually molded or cut from pressure-cast stock. Variations from the dimensions shown on the Drawings shall not be more than the following: thickness, ±1/16 inch; width, -1/8 to +1/4 inch; length, -1/8 to +1/4 inch.

Tolerances, dimensions, finish and appearance, flash, and rubber-to-metal bonding shall conform to the requirements of A 4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be furnished in one piece and shall not be laminated unless otherwise specified. Pads shall be furnished in identifiable packages.

B. Adhesive for use with elastomer pads shall be an epoxy-resin compound compatible with the elastomer having a sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikodur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

C. Laminated pads shall consist of alternate laminations of elastomer and hot-rolled steel sheets molded together as a unit. Outer metal laminations shall be 3/16 inch, and inner laminations shall be 14 gauge. Outer laminations of elastomer shall be 1/4 inch, and inner laminations shall be of equal thickness (at least 3/8 but not more than 1/2 inch), depending on the number of laminations and thickness of the pad. Edges of metal laminations shall have a cover of approximately 1/8 inch of elastomer. The top and bottom bearing surfaces shall each have an integral sealing rib approximately 1/8 inch in depth, in addition to the specified total thickness, and 3/16 inch in width around their peripheries. The bond between the elastomer and metal shall be such that failure shall occur in the elastomer and not between the elastomer and steel when tested for separation. Variations from specified dimensions for individual laminations shall not be more than those specified herein. The total thickness of the complete pad shall not vary more than ±1/8 inch.

D. Material having a nominal durometer hardness of 70 and 50 shall be used for nonlaminated pads and laminated pads, respectively. Test samples will be prepared from finished pads. Samples of each thickness will be taken from 2 full-size pads from each shipment of 300 pads or less, with 1 additional pad for each additional increment of 300 pads or fraction thereof. When tested using the ASTM methods designated, samples shall comply with the following physical requirements.

1. Original Physical Properties: Test results for tear resistance, tensile strength, and ultimate elongation shall not be more than 10 percent below the following specified value:

	Nominal Hardness 50	**Nominal Hardness 70**
Min. tear resistance, ASTM D624, Die C (lb/in of thickness)	180	200
Hardness, ASTM D2240 (points)	50±5	70±5
Min. tensile strength, ASTM D412 (average psi of longitudinal and transverse)	2,500	2,500
Min. ultimate elongation (%)	400	300

2. The compressive deflection tested in accordance with ASTM D575, Method A, shall be as follows:

   a. Laminated Pads: The maximum compression deflection shall be 5 and 7 percent of the total rubber thickness at loads of 500 and 800 pounds per square inch, respectively. The maximum shear resistance shall be 50 pounds per square inch of the plan area at 25 percent shear deformation at –20°F. Test pads shall be subjected to a compressive load of 1.5 times the maximum design load without visible damage to the bearing.

   b. Nonlaminated Pads: When loaded within 300 to 800 pounds per square inch, material shall show a compressive deflection within 20 percent of that given in the charts of Method A, interpolating for actual measured hardness.

3. Changes in Original Physical Properties: When pads are oven aged 70 hours at 212°F in accordance with ASTM D573, changes shall not be more than the following:

Property	Value
Hardness (points change)	0 to +15
Tensile strength (% change)	±15
Ultimate elongation (% change)	-40

4. Extreme Temperature Characteristics: Compression set under constant deflection, ASTM D395, Method B, 22 hours at 212°F, shall not be more than 35 percent. With the low-temperature brittleness test, ASTM D746, breaks shall not occur above –20°F.

5. Ozone Cracking Resistance: Upon exposure to 100 parts per million of ozone in air by volume at a strain of 20 percent and a temperature of 100±2°F in a test otherwise in accordance with ASTM D1149, cracks shall not develop within 100 hours. Samples shall be wiped with solvent before the test to remove traces of surface impurities.

6. Oil Swell: The volume change shall not be more than +120 percent when tested in accordance with ASTM D471 with ASTM Oil No. 3, 70 hours at 212°F.

2.02 TFE BEARING SURFACES

A. TFE resin shall be virgin material conforming to the requirements of ASTM D4894 or D4895. The specific gravity shall be 2.13 to 2.19. The melting point shall be 623±2°F.

B. Filler material shall be milled glass fibers, carbon, or other approved inert filler materials.

C. Adhesive material shall be an epoxy resin conforming to FS MMM-A-134, FEB film or equal, as approved by the Engineer.

D. When tested in accordance with ASTM D4894 or D4895, finished unfilled TFE sheets shall have a tensile strength of at least 2,800 pounds per square inch and an elongation of at least 200 percent.

E. Filled TFE sheets shall contain inert filler material uniformly blended with TFE resin. Finished filled TFE sheets containing glass fiber or carbon shall conform to the following:

	ASTM Method	15% Glass Fibers	25% Carbon
Min. tensile strength	D4894/D4895	2,000 psi	1,300 psi
Min. elongation	D4894/D4895	150%	75%
Min. specific gravity	D792	2.20	2.10
Melting point	D4894/D4895	327±10°C	317 ±10°C

F. Fabric containing TFE fibers shall be manufactured from oriented multifilament TFE fluorocarbon fibers and other fibers as required by specific designs. When tested in accordance with ASTM D2256, the tensile strength of TFE fibers shall be at least 24,000 pounds per square inch and the elongation shall be at least 75 percent.

G. Where TFE sheets are to be epoxy bonded, one surface of the sheet shall be factory treated by an approved manufacturer using the sodium naphthalene or sodium ammonia process.

H. Stainless steel mating surfaces shall be at least 16 gage in thickness and shall conform to the requirements of ASTM A240, Type 304. The mating surface shall be a true plane surface with a Brinnell hardness of at least 125 and a surface finish of an at least No. 8 mirror finish in accordance with ASTM A480. Stainless steel mating surfaces shall be polished or rolled as necessary to conform to the friction requirements specified herein. The stainless steel shall be attached to the sole plate by means of a seal weld around the entire perimeter of the facing material.

I. The coefficient of friction for the completed bearing assembly shall not be more than the following:

Material	Bearing Pressure		
	500 psi (3.447 MPa)	2,000 psi (13.790 Mpa)	3,500 psi (24.132 MPa)
Unfilled TFE, fabric Containing TFE fibers, TFE perforated metal composite	.08	.06	.04
Filled TFE	.12	.10	.08

Material	Bearing Pressure		
	500 psi (3.447 MPa)	2,000 psi (13.790 Mpa)	3,500 psi (24.132 MPa)
Interlocked bronze and filled TFE structures	.10	.07	.05

2.03 PREFORMED FABRIC BEDDING MATERIAL

A. Material shall be composed of multiple layers of 8-ounce cotton duck impregnated and bound with high-quality natural rubber or its equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The number of plys shall be such as to produce the specified thickness after compression and vulcanizing. Finished pads shall withstand compression loads perpendicular to the plane of the laminations of at least 10,000 pounds per square inch without a detrimental reduction in thickness or extrusion.

2.04 ANCHOR RODS

A. Anchor bolts shall be as specified in Section 05 05 23 – Metal Fastening.

2.05 PIPE SLEEVES AND COLLARS

A. Pipe sleeves and collars shall be cut from schedule 40 PVC plastic pipe meeting the requirements of ASTM D1785 unless otherwise noted on the Drawings.

PART 3 – EXECUTION

3.01 STEEL PLATES, SHAPES, AND BARS

A. Unless galvanizing is indicated on the Drawings, items shall be painted in accordance with the Drawings and Section 09 90 00 – Painting.

B. If galvanizing is indicated on the Drawings, steel bearing assemblies for both structural steel beams and girders and prestressed concrete members shall be galvanized as specified in Section 05 05 13 – Galvanizing. Except for attachments of bearing plates to beams, all fabrication and welding of bearing plate assemblies shall be performed before the steel is galvanized. All joints of welded parts shall be sealed with weld material. Welds made for attaching bearing plates to beams or girders shall be cleaned and given 2 coats of zinc rich paint having a minimum total coating thickness of 3 mils.

3.02 BRONZE PLATES

A. Sliding surfaces of bronze plates shall be polished.

3.03 COPPER-ALLOY PLATES

A. Finishing of rolled copper-alloy plates will not be required provided their surfaces are plane, true, and smooth.

3.04 ELASTOMERIC PADS

A. Care shall be taken in fabricating pads and related metal parts so that effects detrimental to their proper performance, such as uneven bearing and excessive bulging, will not occur.

3.05 PLACEMENT OF BEARING PLATES AND PADS

A. Bearing areas shall be finished to a true level plane which shall not vary perceptibly from a straightedge placed in any direction across the area.

B. Bearing plates or pads shall be set level in exact position and shall have a uniform bearing over the entire area. Provision shall be made to keep plates or pads in the correct position during erection of beams or placement of concrete.

C. Elastomeric pads and other flexible bearing materials shall be placed directly on masonry surfaces finished to a roughness equivalent to that of a No. 36 to No. 46 grit. Pads, bearing areas, or bridge seats and metal bearing plates shall be thoroughly cleaned and free from oil, grease, and other foreign materials. Metal bearing plates or bottoms of prefabricated beams that are to bear on elastomeric pads shall be coated with epoxy and then surfaced with a No. 36 to No. 46 silicon carbide or aluminum oxide grit. Bearing areas shall be finished to equivalent roughness.

D. Metal bearing plates shall be bedded on seats as follows:

1. The seat bearing areas shall be thoroughly swabbed with approved paint, and three layers of duck, 12 to 15 ounce per square yard, shall be placed on it, each layer being thoroughly swabbed with paint on its top surface.

2. Superstructure shoes or pedestals shall be placed in position while paint is plastic. As an alternate to duct and paint, preformed fabric bedding material at least 1/8 inch in thickness may be used when called for on the Drawings or approved in writing by the Engineer.

3.06 PLACEMENT OF ANCHOR RODS

A. All necessary anchor rods and bolts (anchors) shall be accurately set either in the concrete as they are being placed, in formed holes, or in holes cored after the concrete has set. If set in the concrete, the rods and bolts shall be accurately positioned by means of templates and rigidly held in position while the concrete is being placed. Holes may be formed by inserting or casting in the fresh concrete oiled wooden plugs, metal pipe or plastic sleeves, or other approved devices, and withdrawing them after the concrete has partially set or left in place as indicated on the Drawing’s or approved by the Engineer. Holes so formed shall be at least 3 inches in diameter or at least 2.5 times

the diameter of the rod or bolt. If cored, holes shall be at least 2.5 times the diameter of the anchor used or as indicated on the Drawings. Equipment used for coring concrete shall have been approved by the Engineer. Impact tools will not be permitted. Reinforcing steel shall be placed to provide adequate space to core rod/bolt holes without cutting the reinforcing steel. For cored holes, anchor rods and bolts shall be adequately held in place at the centroid of the hole or as specified on the Drawings by using approved pre-fabricated equalizers designed to allow grout to penetrate and fill the hole completely and spaced as approved by the Engineer.

B. During freezing conditions, anchor holes shall be protected from water accumulations at all times.

C. Anchors which are to be placed in holes of sufficient and specified diameter after the concrete has set shall be bonded to the concrete with a non-shrink high-strength Portland cement grout in accordance with Section 03 60 00 – Grout or shall be adhesive anchors in accordance with Section 05 05 23 – Metal Fastening. The type anchoring system and grout shall be as indicated on the Drawings. The grout or adhesive shall completely fill the holes. Anchors shall be tested for sufficient pull-out capacity as indicated in applicable sections of the Specifications or as indicated on the Drawings.

D. Anchors that are not designed to project through bearing plates shall be checked for proper projection above the masonry bearing area immediately prior to placement of bearing plates and beams. Nuts on anchor rods at expansion ends shall be adjusted to permit free movement of the span.

E. Angles for anchor assemblies to be attached to sides of concrete beams shall not be installed until beams have received their full dead load and supporting falsework has been removed.

END OF SECTION

SECTION 07 90 00
JOINT FILLERS, SEALANTS AND CAULKING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for the complete execution of Work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 15 00 – Concrete Accessories

B. Section 03 15 16 – Joints in Concrete

C. Section 08 80 00 – Glass and Glazing

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C-920 – Elastomeric Joint Sealants

2. ASTM D-1056 – Flexible Cellular Materials – Sponge or Expanded Rubber

3. SWRI – Sealant and Caulking Guide Specification

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturers literature and installation instructions. Label each product submitted with Type as indicated in paragraph 2.01 A.

2. Color samples of each type of sealant.

1.05 QUALITY ASSURANCE

A. Applicator shall be a company specializing in the installation of sealants with a minimum of five years of experience.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened labeled packages.

B. Store materials in location protected from freezing or damages.

C. Reject and remove from the site materials within broken or damaged packaging.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sealants

1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.

2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by Master Builders Solutions.

3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by Master Builders Solutions.

4. Type 8: Nonsag, Multi Component, traffic grade polyurethane sealant meeting ASTM C920, Type M, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation, Sonolastic Ultra by Master Builders Solutions.

B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this project.

C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2.00 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.

D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.

E. Bond breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.

F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 – EXECUTION

3.01 QUALITY CONTROL

A. Coordinate work with details shown on approved shop drawings prepared by other trades.

B. Verify conditions in the field.

C. Schedule work to follow closely the installation of other trades.

D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.

E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

3.02 PREPARATION

A. Protect finished surfaces adjoining by using masking tape or other suitable materials.

B. Clean and prime joints before starting any caulking or sealing work.

C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.

D. Joint Requirements

1. All joints and spaces to be sealed in exterior work shall be less than ½-inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.

2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than ¼-inch deep, the back-up material may be omitted, a bond breaker substituted and the joint completely filled with sealant. The back-up material shall not project beyond the ¼-inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

Joint Width	Sealant Depth	
	Minimum	Maximum
¼ inch	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 1 inch	1/2 inch	Equal to width
Over 1 inch to 2 inches	1/2 inch	1/2 of width

3.03 APPLICATION

A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.

B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.

C. All joints shall be waterproof and weathertight.

D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.

E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.

F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.04 ADJUSTMENT AND CLEANING

A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.

B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

3.05 SCHEDULE

Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings.	Type 1	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by masonry, precast concrete, natural stone or other porous building material, unless noted otherwise herein or on Drawings.	Type 2	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material.	Type 3	To closely match adjacent surfaces and as selected by the Owner.
Submerged in liquids.[1,2]	Type 1	Manufacturer's standard
Horizontal Joints exposed to vehicular or pedestrian traffic.	Type 8	To closely match adjacent surfaces.
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the Owner.

[1] Sealants which will come in contact with potable water shall meet the requirements of NSF 61.
[2] Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

END OF SECTION

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SECTION 09 90 00
PAINTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.

B. Section Includes:

1. Paint Materials

2. Shop Painting

3. Field Painting

a. Surface Preparation

b. Piping and Equipment Identification

c. Schedule of Colors

d. Work in Confined Spaces

e. OSHA Safety Colors

1.02 RELATED SECTIONS

A. Section 40 05 97 – Piping and Equipment Identification Systems

B. Section 07 90 00 – Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications, the Work shall conform to the applicable requirements of the following documents:

1. SSPC – The Society for Protective Coatings Standards

a. SSPC-Vis 1 – Pictorial Surface Preparation Standards for Painting Steel Structures

b. SSPC-SP2 – Hand Tool Cleaning

c. SSPC-SP3 – Power Tool Cleaning

d. SSPC-SP5/NACE 1 – White Metal Blast Cleaning

e. SSPC-SP6/NACE 3 – Commercial Blast Cleaning

f. SSPC-SP7/NACE 4 – Brush-off Blast Cleaning

g. SSPC-SP10/NACE 2 – Near-White Metal Blast

h. SSPC-SP11 – Power Tool Cleaning to Bare Metal

i. SSPC-SP13/NACE6 – Surface Preparation of Concrete

2. ICRI – International Concrete Repair Institute

3. NACE – National Association of Corrosion Engineers

4. NAFP – The National Association of Pipe Fabricators

5. ASTM D1737 – Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus

6. ASTM B117 – Method of Salt Spray (Fog) Testing

7. ASTM D4060 – Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser

8. ASTM D3359 – Method for Measuring Adhesion by Tape Test

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's literature and Material Safety Data Sheets for each product.

2. Painting schedule identifying surface preparation and paint systems proposed. Cross-reference with Tables 9-1 and 9-2. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and specify shop paint systems for fabricated items.

1.05 SYSTEM DESCRIPTION

A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping,

miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenances.

B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.

C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.

D. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

1.06 QUALITY ASSURANCE

A. Painting operations shall be accomplished by skilled craftsman and licensed by the state to perform painting work.

B. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.

1.07 STORAGE AND DELIVERY

A. Bring materials to the job site in the original sealed and labeled containers.

B. Container label to 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. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

PART 2 – MATERIALS

2.01 GENERAL INFORMATION

A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.

B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the

Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.

C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.

D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.

E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.

F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

2.02 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Tnemec Company Inc.
2. Ameron
3. CARBOLINE
4. Sherwin-Williams
5. International

PART 3 – EXECUTION

3.01 SHOP PAINTING

A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats

may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.

B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.

3.02 SURFACE PREPARATION

A. General

1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.

2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.

3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.

4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.

5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touch-up coats are in addition to the specified applied systems, and not considered a field coat.

6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.

7. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

B. Metal Surface Preparation

1. Prepare all welds to a minimum NACE weld preparation level “C” per NACE Standard SP0178. Provide additional weld preparation where required by the coating manufacturer. Contractor shall provide NACE SP0178 weld mold visual aids on site for evaluation of all weld preparation.

2. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.

3. Perform blast cleaning operations for metal when following conditions exist:

    a. Moisture is not present on the surface.

    b. Relative humidity is below 80%.

    c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.

    d. Painting or drying of paint is not being performed in the area.

    e. Equipment is in good operating condition.

    f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.

4. Abrasive blast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast.

5. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service. Provide a 3.0 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

6. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

7. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system. Abrasive blast clean to increase mechanical adhesion in accordance with ASTM D6386, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting when required by coating manufacturer. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

8. Abrasive blast clean internal and external ductile iron pipe surfaces prior to coating in accordance with NAPF 500-03-04, Surface Preparations Standard for Abrasive Blast Cleaning of Ductile Iron Pipe. Abrasive blast clean internal and external cast ductile iron and cast-iron fitting surfaces in accordance with NAPF-03-05.

9. Prime cleaned metals immediately after cleaning to prevent rusting.

10. Clean rusted metals down to bright metal by abrasive blasting and immediately field primed.

C. Concrete Surface Preparation

1. Cure concrete a minimum of 28 days at 75° F before surface preparation, and painting begins. Allow more time at lower temperatures if specified by paint manufacturer.

2. Test concrete for pH and salts using test methods recommended by the paint manufacturer. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer. Do not begin surface preparation, or painting until acceptable to manufacturer.

3. Moisture content of concrete and masonry surfaces shall conform to manufacturer's recommended limits, and as listed in SSPC-SP13/NACE 6 Section 6 Acceptance Criteria Table 1. Floor surfaces to be coated shall be tested in accordance with ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride or as required by the coating manufacturer. Moisture vapor transmission shall not exceed three pounds per 1,000 square feet in a 24-hour period or less if specified by Coating Manufacturer. Vertical and horizontal overhead surfaces shall be tested in accordance with ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes (relative humidity shall not exceed 80% or as required by the coating manufacturer) or with ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Test Method (test results shall be no moisture present). Engineer or Coating Manufacturer Representative shall specify all test locations. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer.

4. Prepare concrete surfaces to receive coatings in accordance with NACE 6/SSPC-13 – Joint Surface Preparation Standards and ICRI Technical Guidelines. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities using abrasive blasting, shot blasting, water jetting or mechanical abrading. Use dry, oil-free air for blasting operations. Surface texture after blasting shall achieve profile as required by manufacturer or where not defined by manufacturer, profile shall be a minimum ICRI-CSP 5 surface profile. Remove residual abrasives, dust, and loose particles by vacuuming or other approved method.

5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.

6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.

7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.

8. To ease coating around outside corners, provide ¾-inch chamfered edges on all new concrete outside corners and grind existing concrete outside corners to a minimum radius of ¾-inch.

9. Unless recommended otherwise by the coating manufacturer, provide ¼" deep by ¼" wide tool cut terminations at 1-inch maximum from all coating edges for anchorage. Provide terminations around all equipment, piping, openings, gates, top and bottom of walls, stop locations of each day's work and overlap onto previously completed work. Transition coating 3-inches onto interior lining of piping except where coating compatibility concerns are noted by coating manufacturer.

10. Apply epoxy or polymeric filler compatible with painting system to all inside corners of areas to be coated with a margin trowel to form a continuous 45-degree cant cove across corners with a minimum dimension of 1.5-inch. Roughen or prepare cured filler as recommended by coating manufacturer for proper coating adhesion.

11. All equipment grouting shall be installed and cured prior to starting coating work. Coating shall be applied over grout up to the edges of all equipment, gates and uninterrupted piping unless specifically noted otherwise.

D. Wood

1. Clean wood surfaces free of all foreign matter, with cracks and nail holes and other defects properly filled and smoothed. Remove sap and resin by scraping and wipe clean with rags dampened with mineral spirits.

2. Saturate end grain, cut wood, knots, and pitch pockets with an appropriate sealer before priming.

3. Prime and backprime wood trim before setting in place.

4. After prime coat has dried, fill nailholes, cracks, open joints, and other small holes with approved spackling putty. Lightly sand wood trim prior to applying second coat of paint.

E. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.

2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

F. Masonry

1. Cure for a minimum of 30 days prior to paint application.

2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.

3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

G. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.

2. Remove dust, dirt, and other contaminants.

H. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.

2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.

3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.

4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.

5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.03 APPLICATION OF PAINT

A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.

B. Apply paint without runs, sags, thin spots, or unacceptable marks.

C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.

D. Special attention shall be given to nuts, bolts, edges, angles, flanges, etc., where insufficient film thicknesses are likely. Stripe paint prior to applying prime coat. Stripe painting shall be in addition to coats specified.

E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.

F. Allow paint to dry a minimum of twenty-four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.

G. Suspend painting when any of the following conditions exist:

1. Rainy or excessively damp weather.

2. Relative humidity exceeds 85%.

3. General air temperature cannot be maintained at 50□F or above through the drying period, except on approval by the Engineer and paint manufacturer.

4. Relative humidity will exceed 85% or air temperature will drop below 40□F within 18 hours after application of paint.

5. Surface temperature of item is within 5 degrees of dewpoint.

6. Dew or moisture condensation are anticipated.

7. Surface temperature exceeds the manufacturer's recommendations.

H. Where application of coating across concrete control joints or expansion joints has the potential to crack, turn coating into joints and caulk joints with a sealant compatible with coating rated for the intended service per Section 07 90 00.

3.04 INSPECTION

A. Each field coat of paint will be inspected and approved by the Engineer or his authorized representative before succeeding coat is applied. Tint successive coats so that no two

coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.

B. Use magnetic dry film thickness gauges and wet fiber thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.

C. Coatings shall pass a holiday detector test.

D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.

E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.

1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.

F. Paint manufacturer or his representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

A. Use covers, masking tape, other method when protection is necessary, or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint

or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.

B. Take all necessary precautions to contain dispersion of sandblasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the sandblasting debris and paint. Suspend painting operations when sanding debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

3.06 PIPING AND EQUIPMENT IDENTIFICATION

A. Piping and equipment identification shall be in accordance with Section 40 05 97 – Piping and Equipment Identification Systems.

3.07 SCHEDULE OF COLORS

A. Match colors indicated. Piping and equipment colors are indicated in Section 40 05 97 – Piping and Equipment Identification Systems. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.08 WORK IN CONFINED SPACES

A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosion-proof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state and local regulations at all times.

3.09 OSHA SAFETY COLORS

A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not to exceed 2-feet wide by 3-feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.

B. Paint hazardous areas and objects in accordance with OSHA regulations.

Table 1: Painting Schedule

Surface	Application	Painting System and No. of Coats	Product Reference (Table 2)	Total Min. Dry Film Thickness (Mils)
Concrete and Masonry				
Interior masonry and concrete walls	Existing Filter Press Building: Paint all interior walls of the room containing sludge conditioning tanks and lime feed pumps	1 coat sealer 2 coats acrylic epoxy	101 116	75-85 sq.ft./gal. 4-6/coat
Containment Liner[1]	Exterior secondary containment floor, tank supports and walls	2 coats high solids epoxy coating	119	6-10/coat
Metals				
Interior and exterior non-submerged (gloss)	New mechanical equipment, piping, etc.	1 coat epoxy polyamide primer 1 coat epoxy polyamide 1 coat aliphatic polyurethane	104 102 115	4-6 4-6 3-5
Submerged water	New mechanical equipment, piping, etc.	2 coats NSF approved epoxy polyamide	105	4-6/coat
Steel doors, windows and door frames, steel stairs, structural steel, misc. metals (steel)		1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4
Aluminum surfaces in contact with concrete		2 coats coal tar	107	26
Shop Primed Structural Steel	Pre-Engineered Buildings	1 barrier coat 1 coat epoxy 1 coat epoxy	113 114 120	2-3 3-4 3-4
Other				
PVC Piping		1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4

1 Painting manufacturer shall verify compatibility of containment liner and chemical to be contained. Where incompatible substitute a compatible coating system.

Table 2: Product Listing

Ref.	System	Purpose	Product			
			Tnemec Series	PPG/AMERON	CARBOLINE	Sherwin-Williams
101	Acrylic filler	Primer-sealer	130-6601	BLOXFIL 4000	Sanitile 100	Cement-Plex 875
102	Epoxy polyamide	Finish coat semi-gloss or gloss	N69	AMERLOCK 2	Carboguard 890	Dura-Plate 235
103	Acrylic latex	Sealer	1028/1029	PITT TECH PLUS	Carbocrylic 3359DTM	DTM Acrylic Primer/Finish
104	Epoxy Polyamide – metal	Primer	66	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
105	Epoxy	Primer/Finish	20	AMERLOCK 2	Carboguard 561/56LT	Macropoxy 646 PW
106	Coal tar epoxy	Finish high-coat build	46H-413	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
107	Coal tar	Sealer	46-465	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
108	Alkyd-medium oil	Finish coat	2H	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
109	Alkyd-long oil	Finish coat	1029	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
110	Epoxy polyamide	Primer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
112	Epoxy polyamide	Sealer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 920 Pre-Prime
113	Urethane	Barrier coat	530	AMERLOCK SEALER	Rustbond	-
114	Polyamine Epoxy	Intermediate coat	27	AMERLOCK 385	Carboguard 893SG	-
115	Aliphatic Polyurethane	Finish coat	1074 or 1075	AMERCOAT 450 HS	Carbothane 134HG	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	AQUAPON WB	Sanitile 255	Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	1254	AMERLOCK 114	Sanitile 600	Kem Cati-Coat HS Epoxy Filler
118	Catalyzed epoxy	Finish coat	84	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
119	High solids epoxy	Finish coat	104	AMERLOCK 400	Carboguard 890	Dura-Plate 235
120	Epoxy	Top coat	N69	AMERLOCK 2/400	Carboguard 890	-

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SECTION 13 22 00

PRE-ENGINEERED PEDESTRIAN BRIDGE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Work shall include nine fully engineered clear span pedestrian bridges of aluminum construction with aluminum grating walking surfaces and horizontal safety railings. Span lengths and walking surface widths shall be as shown on the contract documents and/or specified herein. The requirements or this specification shall be regarded as minimum standards for design and construction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05 05 23 – Metal Fastening

B. Section 05 10 00 – Metal Materials

C. Section 05 14 00 – Structural Aluminum

D. Section 05 50 00 – Metal Fabrications

E. Section 05 51 00 – Metal Stairs

F. Section 05 53 00 - Gratings

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work hereunder shall conform to the applicable requirements of the following documents to the extent that the requirements therein are not in conflict with the provisions of this Section.

1. Aluminum Association “Specifications for Aluminum Structures”

2. ANSI/AWS – American National Standards Institute / American Welding Society

3. ANSI/AWS D1.2 Structural Welding Code

4. SSRC – Structural Stability Research Council

1.04 QUALIFIED MANUFACTURES

A. Manufacturers/Suppliers must have at least five (5) years’ experience designing and fabricating these type structures and a minimum of five (5) successful bridge projects, of similar construction, each of which has been in service at least three (3) years. List the location, bridge size, owner, and a contact for reference for each project.

B. Acceptable Manufactures/Fabricators shall be Liberty Bridges by Liberty Products, LLC, GatorBridge by CMI Limited Co. or approved equal.

1.05 SUBMITTALS

A. Shop drawings and diagrams shall be submitted to the engineer and owner for review after receipt of order. Submittal drawings shall be unique drawings, prepared to illustrate the specific portion of the work to be done. All relative design information such as member sizes, bridge reactions, design loads and general notes shall be clearly specified on the drawings. Drawings shall have cross referenced details and sheet numbers. All drawings shall be signed and sealed by a licensed Professional Engineer currently registered in the State of Georgia.

B. Structural calculations for the bridge superstructure shall be submitted by the bridge manufacturer and reviewed by the engineer. All calculations shall be signed and sealed by a Professional Engineer currently registered in the State of Georgia. The calculations shall include all design information necessary to determine the structural adequacy of the bridge. The calculations shall include the following:

1. All allowable stress checks for axial, bending and shear forces in the critical member of each truss member type (i.e. top chord, bottom chord, floor beam, vertical, etc.).

2. Checks for the critical connection failure modes for each truss member type (i.e. vertical, diagonal, floor beam, etc.). Special attention shall be given to all welded tube on tube connections.

3. All bolted splice connections.

4. Main truss deflection checks.

5. U-Frame stiffness checks (used to determine K factors for out-of-plane buckling of the top chord) for all half through or "pony" truss bridges.

6. Deck design.

7. Light pole attachment details, see standard detail on electrical drawings.

NOTE: The analysis and design of triangulated truss bridges shall account for moments induced in members due to joint fixity where applicable. Moments due to both truss deflection and joint eccentricity must be considered.

C. Welder certifications in compliance with AWS standard qualification tests.

D. Welding procedures in compliance with Section 5.1.

1.06 WARRANTY

A. The bridge manufacturer shall warrant that it can convey good title to the goods, that they are free of liens and encumbrances and that their aluminum structure(s) are free of design, material and workmanship defects for a period of ten years from the date of delivery.

B. This warranty shall not cover defects in the bridge caused by abuse, misuse, overloading, accident, improper installation, maintenance, alteration or any other cause not expressly warranted. This warranty does not cover damage resulting from or relating to the use of any kind of de-icing material.

C. Repair, replacement or adjustment, at the sole discretion of the bridge manufacturer, shall be the exclusive remedy for defects under this warranty. Under no circumstances shall the bridge manufacturer be liable for any consequential or incidental damages.

D. Any claim under this warranty shall be made promptly and directly to the Bridge Manufacturer who shall have the option, to repair, replace or adjust any covered defect without charge to the original purchaser.

PART 2-- PRODUCTS

2.01 SPAN

A. Bridge span shall be as shown on the contract drawings and shall be as measured from each end of the bridge structure.

2.02 WIDTH

A. Bridge width shall be as required for a 4'-0" wide walking surface as measured from the inside face of structural elements at deck level.

2.03 BRIDGE SYSTEM TYPE

A. Bridge(s) shall be designed as a Pratt Style Truss that has one (1) diagonal per panel and plumb end vertical members. Interior vertical members may be either plumb or perpendicular to the chord faces.

B. Bridge(s) shall be designed utilizing an underhung floor beam (top of floor beam welded to the bottom of the bottom chord) or be designed utilizing an H-Section configuration where the floor beams are placed up inside the trusses and attached to the truss verticals.

C. The bridge manufacturer shall determine the distance from the top of the deck to the top and bottom truss members based upon structural and/or shipping requirements.

D. The top of the top chord shall not be less than 42 inches above the top of the finished walking surface elevation.

E. Bridge end bearing conditions, fixed and/or expansion, shall be as required by the Manufacturers design. Fixed and/or expansion bearing locations as required shall be located on the support columns as shown on the contract drawings.

2.04 MEMBER COMPONENTS

A. All members of the vertical trusses (top and bottom chords, verticals, and diagonals) shall be fabricated from square and/or rectangular aluminum tubing. Other structural members and bracing shall be fabricated from aluminum shapes or square and rectangular aluminum tubing.

B. Unless the floor and fastenings are specifically designed to provide adequate lateral support to the top flange of open shape stringers (w or I-shapes or channels), a minimum of one stiffener shall be provided in each stringer at every floor beam location.

2.05 ATTACHMENTS

A. Safety Rails

1. Horizontal safety rails shall be placed on the structure up to a minimum height of 3′-6″ above the deck surface. Safety rails shall be placed so as to prevent a 19″ sphere from passing through the truss. Safety rails shall be placed on the inside of the structure. Safety rails placed on the inside of the truss shall have their ends sealed and ground smooth so as to produce no sharp edges.

2. The safety rail system shall be designed for the design loads required per the Georgia State Minimum Building Code.

B. Toe Plate

1. The bridge shall be supplied with a removable toe plate mounted to the inside face of both trusses. The toe plate shall be a minimum of 4 inches high. Toe plating will be attached to the truss members at a height adequate to provide a 2″ gap between the bottom of the plate and the top of the deck or the top of the bottom chord, whichever is higher. The span of unstiffened flat toe plating (from center to center of supports) shall not exceed 5′-8″.

2.06 CAMBER

A. The bridge shall have a vertical camber dimension at midspan equal to 100% of the full dead load deflection plus 1% of the full length of the bridge.

2.07 ELEVATION DIFFERENCE

A. The bridge bearing elevations shall be field verified prior to fabrication of the bridge. Manufacturer shall coordinate bearing requirements with the Contractor prior to placement of concrete supports.

PART 3 – EXECUTION

3.01 DESIGN

1. Structural design of the bridge structural system shall be performed by or under the direct supervision of a licensed professional engineer and done in accordance with recognized engineering practices and principles. The design Engineer of Record shall be a Professional Engineer currently registered in the State of Georgia.

B. Design loads shall be in accordance with industry standards but shall not be less than required per applicable portions of the Georgia State Minimum Building Code.

C. The bridge structure design shall consider its own dead load which may include but is not limited to superstructure truss system, decking, walking surface, and safety railing.

D. Uniform Live Load

1. Main Members: Main supporting members, including girders, trusses and arches shall be designed for a pedestrian live load of 85 pounds per square foot of bridge walkway area. The pedestrian live load shall be applied to those areas of the walkway so as to produce maximum stress in the member being designed

2. Secondary Members: Bridge decks and supporting floor systems, including secondary stringers, floor beams and their connections to main supporting members shall be designed for a live load of 85 pounds per square foot.

E. Concentrated Live Loads

a) The bridge superstructure, floor system and decking shall be designed for each of the following point load conditions:

a) A concentrated load of 1,000 pounds placed on any area 2.5 ft x 2.5 ft square.

F. Wind Load

1. Horizontal Forces

a) The bridges shall be designed for wind pressures based on a design wind speed of 120 mph as defined per ASCE 7-10 for a risk category III structure.
b) The wind load shall be applied horizontally at right angles to the longitudinal axis of the structure.
c) The wind loading shall be considered both in the design of the lateral load bracing system and in the design of the truss vertical members, floor beams and their connections.

2. Overturning Forces

a) The effect of forces tending to overturn structures shall be calculated assuming that the wind direction is at right angles to the longitudinal axis of the structure. In addition, an upward force shall be applied at the windward quarter point of the transverse superstructure width. This force shall be 20 pounds per square foot of deck.

3. Top Chord/Railing Loads

a) The top chord, truss verticals, and floor beams shall be designed for lateral wind loads (per Section 3.1.4.1) and for any loads required to provide top chord stability as outlined in Section 3.3.6; however, in no case shall the load be less than 50 pounds per lineal foot or a 200 pound point load, whichever produces greater stresses, applied in any direction at any point along the top chord or at the top of the safety system (42" or 54" above deck level), if higher than the top chord.

4. Load Combinations

a) The loads listed herein shall be considered to act in the combinations required per the Georgia State Minimum Building Code.

G. Deflection

1. Vertical Deflection

   a. The vertical deflection of the main trusses due to service pedestrian live load shall not exceed 1/400 of the span.

   b. The vertical deflection of cantilever spans of the structure due to service pedestrian live load shall not exceed 1/300 of the cantilever arm length.

   c. The deflection of the floor system members (floor beams and stringers) due to service pedestrian live load shall not exceed 1/360 of their respective spans.

   d. The service pedestrian live load shall be 85 PSF.

2. Horizontal Deflection

   a. The horizontal deflection of the structure due to lateral wind loads shall not exceed 1/500 of the span under the wind loads specified in Section 3.03C.

H. Minimum Thickness of Metal

1. The minimum thickness of all aluminum members shall be 1/4" nominal and be in accordance with the Aluminum Association “Specifications for Aluminum Structures.”

I. Welded Tubular Connections

1. When outside the “validity range” defined in these design guidelines, the following limit states or failure modes must be checked:

   a. Chord face plastification
   b. Punching shear (through main member face)
   c. Material failure
      i. Tension failure of the web member
      ii. Local buckling of a compression web member
   d. Weld failure
      i. Allowable stress based on “effective lengths”
      ii. “Ultimate” capacity
   e. Local buckling of a main member face
   f. Main member failure:
      i. Web or sidewall yielding
      ii. Web or sidewall crippling
      iii. Web or sidewall buckling
      iv. Overall shear failure

4. All tubular joints shall be plain unstiffened joints (made without the use of reinforcing plates) except as follows:

5. Floor beams hung beneath the lower chord of the structure may be constructed with or without stiffener (or gusset) plates, as required by design.

6. Floor beams which frame directly into the truss verticals (H-Section bridges) may be designed with or without end stiffening plates as required by design.

7. Where chords, end floor beams and in high profiles the top end struts weld to the end verticals, the end verticals (or connections) may require stiffening to transfer the forces from these members into the end vertical.

8. Truss vertical to chord connections.

   NOTE: The effects of fabrication tolerances shall be accounted for in the design of the structure. Special attention shall be given to the actual fit-up gap at welded truss joints.

J. Top Chord Stability

1. Structural Stability Research Council (SSRC), formerly Column Research Council.

   a. The top chord shall be considered as a column with elastic lateral supports at the panel points. The critical buckling force of the column, so determined, shall exceed the maximum force from dead load and live load (uniform or vehicular) in any panel of the top chord by not less than 50 percent for parallel chord truss bridges or 100 percent for bowstring bridges. The design approach to prevent top chord buckling shall be as outlined by E.C. Holt's research work in conjunction with the Column Research Council on the stability of the top chord of a half-through truss. See Appendix A for the calculation of the spring constant C and the determination of an appropriate K factor for out-of-plane buckling.

K. Bearing Devices

1. Bridge bearings shall consist of an aluminum setting or slide plate placed on the abutment or grout pad. The bridge bearing plate which is welded to the bridge structure shall bear on this setting plate. One end of the bridge will be fixed by fully tightening the nuts on the anchor bolts at that end. The opposite end will have finger tight only nuts to allow movement under thermal expansion or contraction.

2. The bridge bearings shall sit in a recessed pocket on the concrete abutment. The step height (from bottom of bearing to top-of-deck) shall be determined by the bridge manufacturer.

3. Bridges shall have Teflon between the bearing plate and the setting plate. The dimension of the Teflon and both plates shall be enough to provide movement for temperature extremes.

L. Support Bearings

1. The bridge manufacturer shall determine the number, diameter, embedment depth, of all anchor bolts. The anchor bolts shall be Type 316 stainless steel. The anchor bolts shall be designed to resist all horizontal and uplift forces to be transferred by the superstructure to the supporting structures. Engineering design of the bridge supporting structures shall be the responsibility of the support structure engineer. The contractor shall provide all materials, including anchor bolts, for construction of the bridge supporting structures. The contractor shall install the anchor bolts in accordance with the manufacturer's anchor bolt spacing and embedment dimensions. Concrete anchors shall conform to Section 05 05 23 – Metal Fastening.

2. Information as to bridge support reactions and anchor bolt locations will be furnished by the bridge manufacturer after receipt of order and after the bridge design is complete.

3.02 WELDING TESTS

A. Welding and weld procedure qualification tests shall conform to the provisions of ANSI/AWS D1.2 “Structural Welding Code”. Filler metal shall be in accordance with the applicable AWS Filler Metal Specification

3.03 WELDERS

A. Welders shall be properly accredited operators, each of whom shall submit certification of satisfactorily passing AWS standard qualification tests for all positions with unlimited thickness of base metal, have a minimum of 6 months experience in welding tubular structures and have demonstrated the ability to make uniform sound welds of the type required.

PART 4 -- MATERIALS

4.01 Aluminum

A. All bridge components shall be fabricated from extruded aluminum alloy 6061-T6 or 6105-T5, with Aluminum Association M12C22A41 finish, unless otherwise noted.

4.02 DECKING

A. The bridge decking shall be aluminum grating per specification section 05 53 00 - GRATINGS.

PART 5 -- FABRICATION

5.01 GENERAL REQUIREMENTS

A. Drain Holes

1. When the collection of water inside a structural tube is a possibility, either during construction or during service, the tube shall be provided with a drain hole at its

lowest point to let water out.

B. Welds

1. Special attention shall be given to developing sufficient weld throats on tubular members. Fillet weld details shall be in accordance with AWS D1.2. Unless determined otherwise by testing, the loss factor “Z” for heel welds shall be in accordance with AWS Table 2.8. Fillet welds which run onto the radius of a tube shall be built up to obtain the full throat thickness. The maximum root openings of fillet welds shall not exceed 3/16” in conformance with AWS D1.1, Section 5.22. Weld size or effective throat dimensions shall be increased in accordance with this same section when applicable (i.e. fit-up gaps > 1/16”).The fabricator shall have verified that the throat thickness of partial joint penetration groove welds (primarily matched edge welds or the flare-bevel-groove welds on underhung floor beams) shall be obtainable with their fit-up and weld procedures. Matched edge welds shall be “flushed” out when required to obtain the full throat or branch member wall thickness.

   For full penetration butt welds of tubular members, the backing material shall be fabricated prior to installation in the tube so as to be continuous around the full tube perimeter, including corners. Backing may be of four types:

   - A “box” welded up from four (4) plates.
   - Two “channel” sections, bent to fit the inside radius of the tube, welded together with full penetration welds.
   - A smaller tube section which slides inside the spliced tube.
   - A solid plate cut to fit the inside radius of the tube.

   Corners of the “box” backing, made from four plates, shall be welded and ground to match the inside corner radii of the chords. The solid plate option shall require a weep hole either in the chord wall above the “high side” of the plate or in the plate itself. In all types of backing, the minimum fit-up tolerances for backing must be maintained at the corners of the tubes as well as across the “flats”.

D. Paint

1. Aluminum surfaces in contact with concrete all be coated.

5.02 QUALITY CERTIFICATION

A. Bridge(s) shall be fabricated by a fabricator who is currently certified by the American Institute of Steel Construction to have the personnel, organization, experience, capability, and commitment to produce fabricated structural steel for the category “Major Steel Bridges” as set forth in the AISC Certification Program with Fracture Critical Endorsement. Quality control shall be in accordance with procedures outlined for AISC certification. Furthermore, the bridge(s) shall be fabricated in a facility owned and/or leased by the corporate owner of the manufacturer, and fully dedicated to bridge manufacturing.

PART 6 -- DELIVERY AND ERECTION

A. Delivery is made to a location nearest the site which is easily accessible to normal over-the-road tractor/trailer equipment. All trucks delivering bridge materials will need to be unloaded at the time of arrival.

B. The manufacturer will provide detailed, written instruction in the proper lifting procedures and splicing procedures (if required). The method and sequence of erection shall be the responsibility of others.

C. The bridge manufacturer shall provide written inspection and maintenance procedures to be followed by the bridge owner.

END OF SECTION

SECTION 26 05 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.

B. The electrical scope of work for this project primarily includes, but is not limited to, the following:

1. Furnish and install low voltage electrical power distribution equipment.

2. Furnish and install all aboveground raceway systems including conduit, fittings, boxes, supports, and other pertinent components.

3. Furnish and install all underground raceway systems including conduit, fittings, manholes, handholes and other pertinent components.

4. Furnish and install all wire and cable resulting in a complete and operable electrical system.

5. Furnish and install new lighting systems and wiring devices.

6. Other electrical work as specified herein and indicated on the Drawings.

C. All material and equipment must be the product of an established, reputable, and approved manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.

D. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.

E. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.

F. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

G. All electrical components and systems, including electrical equipment foundations, shall be designed to resist operational forces as well as lateral sway and axial motion from seismic and thermal forces. Seismic support design shall be in accordance with Section 01 73 23 – Seismic Anchorage and Bracing.

1.02 EQUIPMENT LOCATION

A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting the work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to ensure that proposed equipment will fit properly in spaces indicated.

B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

1.03 LOCAL CONDITIONS

A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.

B. In addition, the Contractor shall relocate all duct banks, lighting fixtures, receptacles, switches, boxes, and other electrical equipment as necessary to facilitate the Work included in this project. Costs for such work shall be included in the Bid.

C. The Contractor is responsible for coordinating all electric utility equipment installations with the serving electric utility. The Contractor shall furnish and install all electric utility equipment required by the electric utility to be installed by the Contractor whether specifically shown on the Drawings or not.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures and the requirements of the individual Specification Sections, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
2. Operation and Maintenance Manuals
3. Spare Parts List
4. Proposed Testing Methods and Reports of Certified Shop Tests
5. Reports of Certified Field Tests
6. Manufacturer's Representative's Certification

B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.

C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.

D. Some individual electrical specification sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be submitted. If the CD&E letter is required and shop drawings are submitted without the letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

E. Seismic support design for all nonstructural electrical components (conduit, raceways, freestanding equipment, etc.) shall be in accordance with all applicable federal, state/commonwealth and local building code requirements and Section 01 73 23 – Seismic Anchorage and Bracing.

1.05 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the following:

   a. Insurance Rating Organization having jurisdiction

   b. The serving electrical utility company

   c. The currently adopted edition of the National Electrical Code (NEC)

   d. The National Electric Manufacturers Association (NEMA)

   e. The Institute of Electrical and Electronic Engineers (IEEE)

   f. The Insulated Cable Engineers Association (ICEA)

   g. The American Society of Testing Materials (ASTM)

   h. The American National Standards Institute (ANSI)

   i. The requirements of the Occupational Safety Hazards Act (OSHA)

   j. The National Electrical Contractors Association (NECA) Standard of Installation

   k. National Fire Protection Association (NFPA)

   l. International Electrical Testing Association (NETA)

   m. All other applicable Federal, State/Commonwealth and local laws and/or ordinances.

2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.

B. Nonconformance

1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in the Bid. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the

Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.06 TEMPORARY LIGHTING AND POWER

A. The Contractor shall reference the General Conditions and Section 01 51 00 – Temporary Utilities.

1.07 TESTS

A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.

B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.

C. Refer to each individual specification section for detailed test requirements.

D. The Contractor shall complete the installation and field testing of the electrical installation at least two (2) weeks prior to the start-up and testing of all other equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.

E. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, personnel and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any electrical equipment required as part of the field tests of other systems.

1.08 INFRARED INSPECTION

A. Just prior to the final acceptance of a piece of equipment, the Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment terminations.

B. The infrared inspection shall apply to all new equipment and existing equipment that is in any way modified under this Contract. All heating problems detected with new equipment furnished and installed under the Scope of this Contract shall be corrected by the Contractor. All problems detected with portions of existing equipment modified under this Contract shall also be corrected by the Contractor.

C. Any issues detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the Contractor. Despite the Contractor not being held responsible for these problems, the Contractor shall report them to the Owner and Engineer immediately for resolution.

D. The infrared inspection report shall include both digital and IR pictures positioned side by side. Both the digital and IR pictures shall be clear and high quality. Fuzzy, grainy, or poorly illuminated pictures are not acceptable. The IR picture shall be provided with a temperature scale beside it, and an indication of the hot spot temperature in each picture. Reports shall be furnished in a 3-ring binder, with all pages printed in full color, with equipment assemblies separated by tabs.

1.09 PROTECTIVE DEVICE SETTING AND TESTING

A. The Contractor shall provide the services of a field services organization to adjust, set, calibrate and test all protective devices in the electrical system. The organization shall be a subsidiary of or have a franchise service agreement with the electrical equipment manufacturer. The qualifications of the organization and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.

B. All protective devices in the electrical equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.

C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.

D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.

E. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.

F. When completed, the Contractor shall provide a comprehensive report for all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.

G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

1.10 SCHEDULES AND FACILITY OPERATIONS

A. Since the equipment testing required herein shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of facility equipment must be coordinated with the Owner/Engineer so as not to affect proper facility operations.

B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.

C. In the event of accidental shutdown of Owner equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.

D. Maintaining the operation of these facilities during the duration of the construction period is essential and required. The Contractor shall furnish and install temporary equipment as required to maintain facility operation. Reference Section 01 14 00 – Coordination with Owner's Operations for construction sequencing and specific operational constraint information.

1.11 MATERIALS HANDLING

A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. If space heaters are provided in a piece of electrical equipment, they shall be temporarily connected to a power source during storage. The Contractor shall store equipment and materials in accordance with Section 01 55 00 – Contractor Access and Parking.

1.12 WARRANTIES

A. Unless otherwise specified in an individual specification section, all electrical equipment and electrical construction materials shall be provided with a warranty in accordance

with the requirements of Section 46 00 00 – Equipment General Provisions and the General Conditions.

1.13 TRAINING

A. Unless otherwise specified in an individual specification section, all training for electrical equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

PART 2 – PRODUCTS

2.01 PRODUCT REQUIREMENTS

A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.

C. All equipment and materials shall be new, unless indicated or specified otherwise.

D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming to this requirement.

2.02 SUBSTITUTIONS

A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition. The Contractor, in such cases may use any article, device, product, material, fixture, or item of equipment which in the judgment of the Engineer, expressed in writing, is equal to that specified.

2.03 CONCRETE

A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified. Concrete and reinforcing steel shall meet the appropriate requirements of Division 03 of the Specifications.

B. The Contractor shall provide concrete equipment pads for all free-standing electrical apparatus and equipment located on new or existing floors or slabs. The Contractor shall

provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to standard detail for equipment pads shown on the Contract Drawings. Equipment pads shall not have more than 3” excess concrete beyond the edges of the equipment.

C. The Contractor shall provide concrete foundations for all free-standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist and/or are not or provided by others under this Contract. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

PART 3 – EXECUTION

3.01 CUTTING AND PATCHING

A. Coordination

1. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.

B. Damage

1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of this Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at the Contractor’s expense.

C. Existing Equipment

1. Provide a suitable cover or plug for openings created in existing equipment as the result of work under this Contract. For example, provide round plugs in equipment enclosures where the removal of a conduit creates a hole and the enclosure. Covers and plugs shall maintain the NEMA rating of the equipment enclosure. Covers and plugs shall be watertight when installed in equipment located outdoors.

3.02 EXCAVATION AND BACKFILLING

A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 31.

3.03 CORROSION PROTECTION

A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

END OF SECTION

SECTION 26 05 19
LOW VOLTAGE CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, all low voltage wire and cable indicated on the Drawings and as specified herein and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of wire and cable systems shall be furnished and installed by the Contractor.

B. The scope of this Section does not include internal wiring factory installed by electrical equipment manufacturers.

C. Reference Section 26 05 00 – Basic Electrical Requirements and Section 26 05 33.16 – Boxes for Electrical Systems.

1.02 CODES AND STANDARDS

A. Low voltage wire, cable, and appurtenances shall be designed, manufactured, and/or listed to the following standards as applicable:

1. Underwriters Laboratories (UL)

    a. UL 13 – Standard for Power-Limited Circuit Cables

    b. UL 44 – Thermoset-Insulated Wires and Cables

    c. UL 83 – Thermoplastic-Insulated Wires and Cables

    d. UL 1277 – Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members

    e. UL 1581 – Reference Standard for Electrical Wires, Cables, and Flexible Cords

    f. UL 1685 – Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

    g. UL 2250 – Standard for Instrumentation Tray Cable

    h. UL 2556 – Wire and Cable Test Methods

2. American Society for Testing and Materials (ASTM)

a. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire

b. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

c. ASTM B33 – Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes

d. ASTM D69 – Standard Test Methods for Friction Tapes

e. ASTM D4388 – Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes

3. Insulated Cable Engineers Association (ICEA)

a. ICEA S-58-679 – Standard for Control, Instrumentation and Thermocouple Extension Conductor Identification

b. ICEA T-29-250 – Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 210,000 B.T.U./Hour

4. Institute of Electrical and Electronics Engineers (IEEE)

a. IEEE 1202 – Standard for Flame Testing of Cables

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the wire and cable manufacturer and submit the following:

1. Shop Drawings

2. Reports of Field Tests

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.

B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets for the following:

a. Wire and cable

b. Power and control wire terminations

c. Instrumentation cable terminations

d. Pulling lubricant.

2. Cable pulling calculations (if required).

3. Wiring identification methods and materials.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 CABLE PULLING CALCULATIONS

A. Prior to the installation of the wire and cable specified herein, the Contractor shall submit cable pulling calculations for Engineer review and approval when all of the following are true:

1. The amount of cable to be installed will be greater than 200 linear feet between pull points.

2. The installation will have one or more bends.

3. The wire and cable is size #1/0 AWG and larger.

B. Cable pulling calculations shall be performed by a currently registered Professional Engineer in the State or Commonwealth in which the project is located and shall define pulling tension and sidewall loading (sidewall bearing pressure values).

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years. Wire and cable shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. Only one (1) manufacturer for each wire and cable type shall be permitted.

2.02 POWER AND CONTROL WIRE AND CABLE

A. Power wire shall consist of insulated copper conductors. Conductor insulation shall be rated for 90°C in both wet and dry locations, and 600V. Insulated conductors shall be UL 44 Listed as NEC Type XHHW-2.

B. Control wire shall consist of insulated copper conductors with a nylon (or equivalent) outer jacket. Conductor insulation shall be rated 90°C for dry locations, 75°C for wet locations, and 600V. Insulated conductors shall be UL 83 Listed as NEC Type THHN/THWN.

C. Unless specified otherwise herein, conductors shall be stranded copper per ASTM B-8 and B-3, with Class B or C stranding contingent upon the size. Power conductors for lighting and receptacle branch circuits shall be solid copper per ASTM B-3.

D. Power conductor size shall be no smaller than No. 12 AWG and Control conductor size shall be no smaller than No. 14 AWG.

E. Multi-conductor cable assemblies shall include a grounding conductor and an overall PVC jacket. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Multi-conductor cable assemblies shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

F. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, Encore Wire, or equal.

2.03 INSTRUMENTATION CABLE

A. For single-analog signal applications, instrumentation cable shall consist of a single, twisted pair or triad of individually insulated and jacketed copper conductors with an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

B. For multiple-analog signal applications, instrumentation cable shall consist of multiple, twisted pairs or triads (i.e. groups) of individually insulated and jacketed copper conductors with individual pair/triad shields (i.e. group shields) and an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

C. Cable and group shields shall consist of overlapped aluminum/polyester tape/foil providing 100% coverage. Instrumentation cables shall include an overall copper shield drain wire. Cables containing multiple twisted pairs or triads shall also include group shield drain wires.

D. Conductors, including drain wires, shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM B-8, with Class B stranding unless otherwise specified.

E. Instrumentation signal conductor size shall be no smaller than No. 16 AWG.

F. Instrumentation cable shall be Okoseal-N Type P-OS (for single pair or triad applications) or Okoseal-N Type SP-OS (for multiple pair or triad applications) as manufactured by the Okonite Company, Belden equivalent, Southwire Company equivalent, or equal.

2.04 CONDUCTOR IDENTIFICATION

A. Conductors shall be identified using a color-coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:

1. 480/277V AC Power

    a. Phase A – BROWN

    b. Phase B – ORANGE

    c. Phase C – YELLOW

    d. Neutral – GREY

2. 120/208V or 120/240V AC Power

    a. Phase A – BLACK

    b. Phase B – RED

    c. Phase C – BLUE

    d. Neutral – WHITE

3. DC Power

    a. Positive Lead – RED

    b. Negative Lead - BLACK

4. DC Control

    a. All wiring – BLUE

5. 120 VAC Control

    a. 120 VAC control wire shall be RED except for a wire entering a motor control center compartment, motor controller, or control panel which is an interlock.

This interlock conductor shall be color coded YELLOW. For the purposes of this Section, an interlock is defined as any wiring that brings voltage into the above-mentioned equipment from a source outside that equipment.

6. 24 VAC Control

    a. All wiring - ORANGE

7. Equipment Grounding Conductor

    a. All wiring - GREEN

B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified by the use of colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color-coding requirements listed above.

C. Conductors that are part of multi-conductor cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified by the use of colored tape. Heat shrink tags and colored tape shall be in accordance with the requirements listed in Part 3 herein. Tape color and heat shrink tag background color shall be in accordance with the color-coding requirements listed above.

2.05 CABLE PULLING LUBRICANTS

A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 Plus by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

PART 3 – EXECUTION

3.01 WIRE AND CABLE INSTALLATION

A. General

1. Wire and Cable shall be installed as specified herein and indicated on the Drawings. Unless specifically indicated otherwise on the Drawings, wire and cable shall be installed in separate raceways according to wiring type. For example, power wiring shall not be combined with control wiring, and control wiring shall not be combined with instrumentation wiring.

2. Wire shall be furnished and installed as single conductor cables, with limited exceptions. Multi-conductor cable assemblies shall only be installed where indicated on the Drawings, required by the NEC, or after obtaining written permission from the Engineer.

3. Where instrumentation cables are installed in control panels, motor controllers, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.

4. Instrumentation cable shielding shall be continuous and shall be grounded at one point only.

B. Splices

1. Splices shall not be allowed in power or control wire and cable unless approved in writing by the Engineer. If unique field conditions exist or pulling calculations indicate that splices may be required, the Contractor shall submit a detailed request indicating why splices are required to the Engineer. The Engineer shall be under no obligation to grant such request.

2. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits.

3. No splicing of instrumentation cable is permitted.

C. Wire and Cable Sizes

1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured from source to load does not exceed 2-1/2%.

D. Additional Conductor Identification

1. In addition to the color-coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.

2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.

3. All wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.

4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the required text. The use of handwritten text for wire identification shall not be permitted.

5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.

6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.

7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or equal.

8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all of the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the ‘FROM’ and ‘TO’ column for that particular conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties and shall be made of polyethylene as manufactured by Brady, Seton, Panduit, or equal.

9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

E. Wiring Supplies

1. Rubber insulating tape shall be in accordance with ASTM D4388. Friction tape shall be in accordance with ASTM D69.

F. Training of Cable in Manholes, Handholes, and Vaults

1. The Contractor shall furnish all labor and material required to train cables around cable vaults, manholes, and handholes. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing.

2. Instrumentation cable shall be racked and bundled separate from AC wiring to maintain the required separation as follows:

    a. 18 inches for 480/277 VAC wiring

    b. 12 inches for 208/120 VAC wiring

    c. 6 inches for 24 VAC wiring

G. Conductor Terminations

1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment Specification Sections as applicable for additional termination requirements.

2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the Contractor shall terminate field wiring in an adjacent junction box per the requirements of Section 26 05 33.16 – Boxes for Electrical Systems, complete with terminal strips. Contractor shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.

3. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.

4. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.

5. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

H. Pulling Temperature

1. Cable shall not be installed when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be

pulled with an ambient temperature of 40°F or less within a three (3) day period prior to pulling, the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the workday for which the cable is removed from the protected storage. Any cable reels with wire remaining on them shall be returned to storage at the completion of the workday.

3.02 TESTING

A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Shop Test

a. Wires and cables shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.

2. Field Tests

a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.

b. After installation, wires and cables shall be tested for insulation resistance levels between conductors of the same circuit and between conductor and ground as follows:

1) For #8 AWG and larger 600V wire and cable, apply 1,000 VDC from a Megohmmeter for one (1) minute. Resistance shall be no less than 100 Megohms.

2) Instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter or approved equal. The resistance value shall be 200 Megohms or greater.

3) Insulation resistance testing is not required for power and control cables smaller than #8 AWG.

c. Wires and cables shall be tested after required terminations are made, but before being connected to any equipment.

d. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner. All conductors of a multi-phase circuit shall be replaced if one conductor fails the required testing. If part of a multi-set (parallel conductors per phase) circuit fails testing, only the set containing failure shall be replaced.

e. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

Exhibit A
Test Data – Megohms
Test No. ____

Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conductors	Size:	AWG MCM Shield:
Insulation Material:			Insulation Thickness:		Voltage Rating:		Age:
Type: _____ Pothead _____ Terminal					Location: Indoors _____ Outdoors _____		
Number and Type of Joints:							
Recent Operating History:							
Manufacturer:							
State if Potheads or Terminals were grounded during test:							
List associated equipment included in test:							
Miscellaneous Information:							

Exhibit A
Test Data – Megohms
Test No. ____

Part Tested:	Test Performed: _____ Hours/Days: _____ After Shutdown: _____
Grounding Time:	Dry Bulb Temperature: _____ Wet Bulb Temperature: _____
Test Voltage:	Equipment Temperature: _____ How Obtained: _____ Relative Humidity: _____ Absolute Humidity: _____ Dew Point: _____

Megohmmeter: Serial Number: _____ Range: _____
Voltage: _____ Calibration Date: _____

Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
1/4 Minute				5 Minutes			
1/2 Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minute Ratio			

Remarks:

END OF SECTION

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.

B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100. Conflicts shall be promptly brought to the attention of the Engineer.

C. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded:

D. Reference Section 26 05 00 – Basic Electrical Requirements

1.02 CODES AND STANDARDS

A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:

1. UL 467 – Grounding and Bonding Equipment

2. IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

3. IEEE 1100 – Recommended Practice for Power and Grounding Electronic Equipment

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Reports of certified field tests.

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 GROUND RODS AND GRID

A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod. Ground rods shall be UL 467 listed. The ground rods shall be manufactured by Erico Products, Blackburn, or equal.

B. Except where specifically indicated otherwise, all exposed non current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.

C. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 FITTINGS

A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 listed.

2.04 EQUIPMENT GROUNDING CONDUCTORS

A. An insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the ungrounded conductors in the raceway and shall be green in color. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.05 EQUIPMENT GROUNDS

A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

B. For all control panels, disconnect switches, and other electrical enclosures, equipment grounds and bonding jumpers shall be terminated individually on a ground bar or mechanical lugs. No wire nuts will be permitted.

2.06 EXOTHERMIC WELDS

A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.

B. Ground Grid

1. Grounding shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. Ground rods shall be driven straight down into the earth, or if objects are encountered, at an angle to avoid the obstruction.

2. The ground rods shall be interconnected by the use of copper cable exothermically welded to the rods. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtails" shall be connected to the ground grid and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system. The copper pigtails shall be exothermically welded to the ground grid and connected to building reinforcement steel by hydraulic crimp.

3. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.

4. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.

5. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.

6. Buried exothermic welds and ground ring shall not be backfilled until inspected by Engineer.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Witnessed Shop Tests

a. None required.

2. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

b. Fall of potential tests shall be performed on the ground grid per IEEE81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.

c. Continuity tests for the grounding electrode conductor shall be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

END OF SECTION

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install structural supports for mounting and installing all conduit, electrical equipment, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.

B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.

C. Reference Section 26 05 00 – Basic Electrical Requirements.

1.02 CODES AND STANDARDS

A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:

1. ASTM A123 – Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

2. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.

3. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

4. ASTM A276 – Standard Specification for Steel Bars and Shapes

5. ASTM B783 – Standard Specification for Materials for Ferrous Powder Metallurgy Structural Parts

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop drawings

2. Structural support calculations (if required)

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 MATERIALS

A. Support channel shall be 1-5/8” by 1-5/8” minimum, with 12 gage material thickness.

B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Material of Construction
All Outdoor Areas	Type 304 Stainless Steel

C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which

they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Material of Construction
All Outdoor Areas	Type 304 Stainless Steel

PART 3 – EXECUTION

3.01 INSTALLATION

A. Concrete or Masonry Inserts

1. The Contractor shall be responsible for the furnishing and installation of all anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.

2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.

2. Unless otherwise indicated on the Drawings or in the Specifications, guards/handrails shall not be utilized as supports for electrical equipment, devices, or appurtenances. Guards/handrails shall not be cut, drilled, or otherwise modified in order to accommodate electrical supports without written approval from the Engineer.

3. Support channel shall be provided wherever required for the support of switches, panels, and miscellaneous equipment.

4. All equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Support channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.

5. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework.

6. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.

7. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; Contractor shall submit design details to the Engineer for acceptance before proceeding with the fabrication.

8. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

9. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the Contractor shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a registered Professional Engineer in the State or Commonwealth in which the project is located.

    a. A quantity of twelve (12) or more conduits trade size 1” and smaller are proposed for a conduit support rack.

    b. A quantity of eight (8) or more conduits trade sizes 1 ½” to 2 1/2” are proposed for a conduit support rack.

    c. A quantity of four (4) or more conduits trade sizes 3” and larger are proposed for a conduit support rack.

10. Single conduits installed exposed along walls shall be secured to the wall or ceiling with a one-hole conduit clamp and clamp-back. Where multiple conduits are installed exposed together, support channel and conduit clamps shall be used.

C. Equipment, boxes, and enclosures which are factory-constructed with integral mounting provisions (such as brackets., mounting feet, bolt holes, etc.) shall be installed/supported utilizing those mounting provisions. Equipment, boxes and enclosures shall not be field-modified by any means which compromises the UL listing or NEMA rating of the enclosure/assembly.

END OF SECTION

SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein, indicated on the Drawings, and as required.

B. Requirements for conduit clamps, support systems, and anchoring are not included in this Section. Reference Section 26 05 29 – Hangers and Supports for Electrical Systems, for these requirements.

C. Reference Section 26 05 00 – Basic Electrical Requirements.

1.02 CODES AND STANDARDS

A. Conduits and conduit fittings shall be designed, manufactured, and/or listed to the following standards as applicable:

1. American National Standards Institute (ANSI)

    a. ANSI B1.20.1 – Pipe Threads, General Purpose

    b. ANSI C80.1 – Electrical Rigid Steel Conduit

    c. ANSI C80.5 – Electrical Rigid Aluminum Conduit

    d. ANSI FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

2. Underwriters Laboratories (UL)

    a. UL 6 – Electrical Rigid Metal Conduit-Steel

    b. UL 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel

    c. UL 360 – Standard for Liquid-tight Flexible Metal Conduit

    d. UL 467 – Grounding and Bonding Equipment

    e. UL 514B – Conduit, Tubing, and Cable Fittings

    f. UL 651 – Standard for Schedule 40 and 80 Conduit and Fittings

g. UL 1479 – Standard for Fire Tests of Penetration Fire Stops

h. UL 1660 – Liquid-tight Flexible Nonmetallic Conduit

3. National Electrical Manufacturer's Association (NEMA)

a. NEMA FB 2.40 – Installation Guidelines for Expansion and Expansion/Deflection Fittings

b. NEMA RN 1 – PVC Externally Coated Galvanized Rigid Steel Conduit

c. NEMA RV-3 – Application and Installation Guidelines for Flexible and Liquid-tight Flexible Metal and Nonmetallic Conduits

d. NEMA TC-2 – Electrical PVC Conduit

e. NEMA TC-3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing

4. National Electrical Contractors Association (NECA)

a. NECA 1 – Standard for Good Workmanship in Electrical Construction

5. Others

a. ACI-318 – Building Code Requirements for Structural Concrete

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets for conduits and fittings.

2. Conduit identification methods and materials.

3. Evidence of training for all personnel that will install PVC coated rigid metal conduit.

1.05 DEFINITIONS

A. Conduits are categorized by the circuit type of the wiring to be installed inside. Conduits are defined as follows:

1. Power Conduits – Conduits that carry AC or DC power wiring from a source to a load. Conduits that carry lighting and receptacle wiring.

2. Control Conduits – Conduits that carry AC or DC discrete control wiring between devices and/or equipment. Conduits that carry fiber optic cables between devices and/or equipment.

3. Instrumentation Conduits – Conduits that carry AC or DC analog signal wiring between devices and/or equipment.

B. Conduit categories are indicated on the Drawings by the leading letter of the conduit tag. Conduit tag leading letters are defined as follows:

1. P – Power Conduit

2. C – Control Conduit

3. I – Instrumentation Conduit

PART 2 – PRODUCTS

2.01 GENERAL

A. Conduit and conduit fitting products are specified in the text that follows this article. Reference Part 3 herein for the application, uses and installation requirements of these conduits and conduit fittings.

B. All metallic conduit fittings shall be UL 514B and UL 467 Listed and constructed in accordance with ANSI FB 1. All metallic conduit fittings for use in Class I Division I hazardous areas shall be UL 1203 Listed. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.

C. Where threading is specified herein for conduit fitting connections, the fittings shall be manufactured to accept conduit that is threaded to ANSI B1.20.1 requirements.

D. Conduit expansion fittings for all conduit materials of construction shall be capable of 4 inches of movement along the axis of the conduit for trade sizes 2 inches or less.

Expansion fittings shall be capable of 8 inches of movement along the axis of the conduit for trade sizes greater than 2 inches.

E. Conduit deflection fittings for all conduit materials of construction shall be provided with a flexible neoprene outer jacket that permits up to ¾ inch of expansion/contraction along the axis of the conduit as well as up to ¾ inch of parallel misalignment between the conduit axes. Outer jacket shall be secured to the conduit hubs by stainless steel clamps.

F. Conduit seals shall either be Listed and labeled for 40% fill, or conduit reducing fittings and a trade size larger conduit seal shall be provided to achieve 25% or less fill within the seal. Percentage fill calculation shall be based on the conductors to be installed. Conduit seals shall be provided with breathers and/or drains where required by the NEC.

G. Conduit insulating bushings shall be constructed of plastic and shall have internal threading.

H. Additional conduit and conduit fitting requirements are specified in the articles that follow based on the specific conduit material of construction to be used.

2.02 RIGID GALVANIZED STEEL (RGS) CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1 and shall be UL 6 Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Galvanized Steel

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies shall be provided with covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Galvanized Steel

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Galvanized Steel

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of bronze or an electro-galvanized malleable iron alloy. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Termination Fittings for use with Rigid Galvanized Steel

1. Conduit hubs shall be constructed of stainless steel and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.

3. Conduit bonding bushings shall be constructed of zinc plated malleable iron. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.03 RIGID NONMETALLIC CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be Schedule 40 or 80 (dependent on application) polyvinyl chloride (PVC) construction, manufactured in accordance with NEMA TC-2, UL 651 Listed, and suitable for conductors with 90 degree C insulation.

B. Conduit Bodies for use with Rigid Nonmetallic Conduit

1. Conduit bodies shall be constructed of PVC. Conduit hubs shall be integral to the conduit body and shall be smooth inside to accept a glued conduit connection.

2. Conduit body shall be provided with cover that is affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Unions for use with Rigid Nonmetallic Conduit

1. Conduit couplings and unions shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

D. Conduit Expansion and Deflection Fittings for use with Rigid Nonmetallic Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

E. Conduit Termination Fittings for use with Rigid Nonmetallic Conduit

1. Conduit hubs shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. Hubs shall have external threads and an accompanying PVC locknut, and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts constructed of PVC and locknuts with integral gasket or seal are not acceptable.

3. Conduit end bells shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. End bell shall have a smooth inner surface that curves outward towards the edge of the fitting.

2.04 PVC COATED RIGID GALVANIZED STEEL CONDUIT AND ASSOCIATED FITTINGS

A. General

1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.

2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

B. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1 and shall be UL 6 Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN 1.

C. Conduit Bodies for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by stainless steel screws which thread directly into the conduit body and have a plastic encapsulated head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Galvanized Steel Conduit

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of bronze or an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

F. Conduit Termination Fittings for Use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit hubs shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit bonding bushings shall be constructed of zinc plated malleable iron which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.05 RIGID ALUMINUM CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be made of heavy wall high strength 6063 alloy aluminum with temper designation T1. Conduit shall be manufactured in accordance with ANSI C80.5 and shall be UL 6A Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Aluminum Conduit

1. Conduit bodies shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies shall be provided with stamped copper-free aluminum covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Aluminum Conduit

1. Couplings and nipples shall be threaded and shall be constructed of heavy wall high strength 6063 alloy aluminum with temper designation T1. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of copper-free aluminum which is coated with an aluminum enamel finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Aluminum Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Termination Fittings for use with Rigid Aluminum Conduit

1. Conduit hubs shall be constructed of copper-free aluminum and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of copper-free aluminum. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.

3. Conduit bonding bushings shall be constructed of copper-free aluminum. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.06 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4 inch and smaller conduits shall be provided with an integrally woven copper bonding strip.

2. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed. Conduits shall be Listed for and marked with maximum temperature ratings as follows:

a. 105 degrees C dry, 60 degrees C wet for all conduit installed against or within 2 inches of equipment capable of having a surface temperature of 80 degrees C or greater (e.g. blowers, incinerators, etc)

b. 80 degrees C dry, 60 degrees C wet for all other locations

B. Conduit Termination Fittings for use with LFMC

1. Conduit termination fittings shall be constructed of either 304 stainless steel or an electro-galvanized malleable iron alloy which is coated on the exterior with a 40 mil (minimum) PVC jacket and coated on the interior with a 2 mil (minimum) layer of urethane. PVC coated fittings shall have a sealing sleeve constructed of PVC which covers the connection to conduit.

2. Termination fittings shall have a threaded end with matching locknut and sealing ring for termination to equipment and shall have an integral external bonding lug where required for proper bonding. Termination fittings shall have a plastic

insulated throat and shall be watertight when assembled to the conduit and equipment.

2.07 LIQUID TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be constructed of rigid polyvinyl chloride (PVC), fabricated to provide flexibility. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 1660 Listed.

B. Conduit Termination Fittings for use with LFNC

1. Conduit termination fittings shall be constructed PVC and shall have a threaded end with matching locknut and sealing ring for termination to equipment. Termination fittings shall be watertight when assembled to the conduit and equipment.

2.08 FLEXIBLE METAL CONDUIT (FMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Conduit shall be UL 1 Listed.

B. Conduit Termination Fittings for use with FMC

1. Conduit termination fittings shall be constructed of an electro-galvanized malleable iron alloy. Fittings shall have a threaded end with matching locknut for termination to equipment, and a compression-style connection to the associated conduit.

2.09 CONDUIT BENDS

A. Rigid conduit bends, both factory-fabricated and field-fabricated, shall meet the same requirements listed in the articles above for the respective conduit type and material of construction.

B. Conduit bend radii for standard radius bends shall be no less than as follows:

Trade Size (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
Min. Radius (inches)	4-1/2	5-3/4	7-1/4	8-1/4	9-1/2	10-1/2	13	15	16	24	30

C. Conduit bend radii for long radius bends shall be no less than as follows:

Trade Size (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
Min. Radius (inches)	N/A	12	18	24	30	30	36	36	48	48	60

2.10 MISCELLANEOUS

A. Conduit Periphery Sealing

1. The sealing of the exterior surface of conduits to prevent water and/or air from passing around the conduit periphery from one space to another (where required) shall be through the use of one of the following:

   a. A conduit sleeve and pressure bushing sealing system. Acceptable products are FSK by OZ-GEDNEY, Link-Seal by Crouse-Hinds, or Engineer approved equal.

   b. A conduit sleeve that is two trade sizes larger than the conduit being sealed, with 2-hour fire rated UL 1479 Listed caulk filling the entire void between the conduit and sleeve. This method is only suitable for penetrations in non-fire rated walls and floors between spaces within buildings. This method shall not be used for the sealing of conduits leaving a building and/or structure.

2. Conduit penetrations through fire-rated walls and floors shall be made with an approved UL 1479 Listed product specifically intended for the trade size of the conduit.

B. Primer and Cement

1. Nonmetallic conduit shall be cleaned with primer and connected to fittings with the manufacturer’s recommended cement that is labeled Low VOC.

C. Galvanizing Compounds

1. Galvanizing compounds for field application shall be the cold-applied type, containing no less than 93% pure zinc.

D. Conduit Interior Sealing

1. The sealing of the inside of conduits against water ingress shall be achieved through the use of one of the following:

   a. Two-part expanding polyurethane foam sealing compound, dispensed from a single tube which mixes the two parts as it is injected into the conduit. Expanding foam shall be compatible with the conduit material of construction

as well as the outer jacket of the cables in the conduit. Acceptable products are Q-Pak 2000 by Chemque, FST by American Polywater Corporation, or Hydra-seal S-60 by Duraline.

b. Inflatable bag that provides seal around cables and around inside diameter of conduit. Provide appropriate quantity of additional fittings for applications with three or more cables in the conduit to be sealed. Acceptable products are Rayflate by Raychem, or Engineer approved equal. This sealing method is only applicable to conduits trade size 2 inch and larger.

c. Neoprene sealing ring provided with the required quantity and diameter of holes to accommodate the cables in each conduit. Sealing ring shall be compressed by two stainless steel pressure plates. Acceptable products are type CSB by OZ-GEDNEY, or Engineer approved equal. This sealing method is only applicable to metallic conduits containing 4 or less cables.

2. The use of aerosol-based expanding foam sealants or any other method of sealing against water ingress not listed above is not acceptable.

E. Pull Rope

1. Pull ropes for empty and/or spare conduits shall be woven polyester, ½-inch wide, with a minimum tensile strength of 1250 lbs.

2. Pull ropes for the Contractors use in installing conductors shall be the size and strength required for the pull and shall be made of a non-metallic material.

PART 3 – EXECUTION

3.01 GENERAL

A. All conduit and associated fittings and appurtenances shall be installed in accordance with NECA 1.

B. Minimum trade size for all rigid conduits shall be 3/4 inch in exposed applications and 1 inch in embedded applications. Conduits installed within ductbanks shall be allowed to be increased in size to trade size 2 inch, at the Contractor's option, to accommodate the saddle size of the ductbank spacers. However, no combining of circuits shall be allowed in the larger conduits.

C. Minimum trade size for flexible conduits (where specifically allowed herein) shall be 1/2 inch in all applications.

D. Conduit routing and/or homeruns within structures is not shown on the Drawings. Conduits shall be installed concealed wherever practical and within the limitations specified herein. All other conduits not capable of being installed concealed shall be installed exposed.

E. Empty and/or spare conduits shall be provided with pull ropes which have no less than 12 inches of slack at each end.

F. Nonmetallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, cleaned of debris, and primer shall be applied to ready each joint for fusing. Conduits shall then be fused together with the conduit manufacturer's approved cement compound.

G. Metallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, be cleaned of all debris and be de-burred, then threaded. Conduit threading performed in the field shall be ¾ inch per foot tapered threads in accordance with ANSI B1.20.1.

H. Conduits shall be protected from moisture, corrosion, and physical damage during construction. Install dust-tight and water-tight conduit fittings on the ends of all conduits immediately after installation and do not remove until conductors are installed.

I. Conduits shall be installed to provide no less than 12 inches clearance from pipes that have the potential to impart heat upon the conduit. Such pipes include, but are not limited to, hot water pipes, steam pipes, exhaust pipes, and blower air pipes. Clearance shall be maintained whether conduit is installed in parallel or in crossing of pipes.

J. Where non-metallic instrumentation conduits are installed exposed, the following clearances to other conduit types shall be maintained:

    1. Instrumentation conduits installed parallel to conduits with conductors energized at 480V or above shall be 18 inches.

    2. Instrumentation conduits installed parallel to conduits with conductors energized at 240V and below shall be 12 inches.

    3. Instrumentation conduits installed at right angles to conductors energized at 480V and below shall be 6 inches.

    4. Instrumentation conduits installed at right angles to conductors energized at voltages above 480V shall be 12 inches.

K. Where conduit fittings do not include an integral insulated bushing, an insulated bushing shall be installed at all conduit termination points.

L. In no case shall conduit be supported or fastened to another pipe or be installed in a manner that would prevent the removal of other pipes for repairs.

M. All field fabricated threads for rigid galvanized steel conduit shall be thoroughly coated with two coats of galvanizing compound, allowing at least two minutes to elapse between coats for proper drying.

N. The appropriate specialized tools shall be used for the installation of PVC coated conduit and conduit fittings. No damage to the PVC coating shall occur during installation. Conduit and conduit fittings with damaged PVC coating shall be replaced at the Contractor's cost. The use of PVC coating touch-up compounds is not permitted.

O. Conduits which emerge from within or below concrete encasement shall be PVC coated rigid galvanized steel in accordance with Standard Detail E-26-0102 where the conduit is not protected by an equipment enclosure that surrounds the conduit on all sides at the point where it emerges from the encasement.

P. Aluminum conduits shall not be installed in direct contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one-hole electro-galvanized malleable iron alloy straps with matching clamp-backs to space the conduit ¼ inch away from concrete surface. Where aluminum conduit passes through concrete, the penetration shall be made such that the aluminum conduit does not come in contact with concrete or mortar.

3.02 CONCEALED AND EMBEDDED CONDUITS

A. Conduits are permitted to be installed concealed and/or embedded with the following requirements:

1. Conduits installed embedded within concrete floors or walls shall be located so as not to affect the designed structural strength of the floor or wall. Embedded conduits shall be installed in accordance with Standard Detail S-03-0403 and ACI-318.

2. Where conduit bends emerge from concrete embedment, none of the curved portion of the bend shall be visible. Only the straight portion of the bend shall be visible. The straight portion shall emerge perpendicular to the embedment (i.e. neatly oriented 90-degrees to floor/slab/grade). Conduits that emerge in a non-perpendicular orientation are not acceptable.

3. Where multiple conduits emerge from concrete embedment or from concealment below a concrete floor, ample clear space shall be provided between conduits to allow for the appropriate and required conduit termination fittings to be installed.

4. Conduits installed embedded within concrete encasement of any kind shall be installed such that conduit couplings for parallel conduits are staggered so that they are not side by side.

B. Conduits are NOT permitted to be installed concealed and/or embedded for the following situations:

1. Conduits shall not be installed embedded within any water-bearing floors or walls. Conduits shall not be installed embedded within any liquid containment area floors or walls.

3.03 CONDUIT USES AND APPLICATIONS

A. Rigid Conduit

1. Rigid conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

Rigid Conduit for Non-Hazardous Areas

Installation Area Designation / Scenario	Conduit Category by Wiring / Circuit Type	
	Power and Control	**Instrumentation**
Exposed in outdoor areas	PVC coated rigid galvanized steel conduit	Same as Power and Control
Concealed within underground direct-bury or concrete-encased ductbanks	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within non-elevated (i.e. "slab-on-grade" construction) concrete slabs	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within elevated concrete slabs	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material)	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within concrete walls	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit

2. The tables for the materials of construction for rigid conduits are intended to exhaustively cover all possible scenarios and installation areas under this Contract. However, if a scenario or installation area is found that is not explicitly governed by these tables, it shall be assumed for bid purposes that the conduit material of construction is to be PVC coated rigid galvanized steel. This discrepancy shall be brought to the attention of the Engineer (in writing) immediately for resolution.

B. Conduit Bends

1. All conduit bends shall be the same material of construction as the rigid conduit listed in the tables above, with the following exceptions:

   a. All 90-degree bends or combinations of adjacent bends that form a 90-degree bend where concealed within concrete or below a concrete slab shall be rigid galvanized steel.

2. Field fabricated bends of metallic conduit shall be made with a bending machine and shall have no kinks. Field fabricated standard radius and long radius bends shall have minimum bending radii in accordance with the associated tables in Part 2 herein.

3. Field bending of non-metallic conduits is not acceptable, factory fabricated bends shall be used.

4. Long radius bends shall be furnished and installed for the following specific applications, all other bends shall be standard radius:

    a. Where specifically indicated on the Drawings.

C. Flexible Conduit

1. Flexible conduit shall only be installed for the limited applications specified herein. Flexible conduit shall not be installed in any other application without written authorization from the Engineer. Acceptable applications are as follows:

    a. Connections to motors and engine-generator sets (and similar vibrating equipment)

    b. Connections to solenoid valves and limit switches

    c. Connections to instrument transmitters and elements

    d. Where specifically indicated in the Standard Details

2. Flexible conduit length shall be limited to three (3) feet, maximum. Flexible conduit shall not be installed buried or embedded within any material.

3. Unless otherwise specified herein, flexible conduits shall be installed in accordance with the Installation Guidelines published within NEMA RV-3.

4. Flexible conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

Flexible Conduit for Non-Hazardous Areas

Installation Area Designation / Scenario	Conduit Category by Wiring / Circuit Type	
	Power and Control	**Instrumentation**
Exposed in outdoor areas	Liquid-tight flexible metal conduit	Same as Power and Control

3.04 CONDUIT FITTING USES AND APPLICATIONS

A. General

1. Conduit fittings shall be furnished and installed in the materials of construction as indicated in Part 2, herein. Conduit fitting materials of construction are dependent on the material of construction used for the associated conduit.

2. Conduit fittings shall be provided in the trade size and configuration required to suit the application.

B. Conduit Bodies

1. Conduit bodies shall be installed where wire pulling points are desired or required, or where changes in conduit direction or breaking around beams is required.

2. Where conduit bodies larger than trade size 2 inches are intended to be used as a pull-through fitting during wire installation, oversized or elongated conduit bodies shall be used. Oversized or elongated conduit bodies shall not be required if the conduit body is intended to be used as a pull-out point during wire installation.

C. Conduit Nipples and Unions

1. Conduits with running threads shall not be used in place of 3-piece couplings (unions) or close nipples. After installation of a conduit fitting of any kind, there shall be no more than ¼ inch of exposed threads visible. Factory fabricated all-thread nipples may be used between adjacent enclosures, however, the same restriction applies regarding the length of exposed threads that are visible.

D. Conduit Expansion and Deflection Fittings

1. Conduit expansion fittings shall be installed where required by the NEC and where indicated on the Drawings. Expansion fittings shall also be installed for exposed straight metallic conduit runs of more than 75 feet, in both indoor and outdoor locations. Expansion fittings for runs of non-metallic conduit shall be installed in accordance with the NEC.

2. Conduit deflection fittings shall be installed where required by the NEC and where conduits are installed (exposed and concealed) across structural expansion joints.

3. Unless otherwise specified herein, conduit expansion and deflection fittings shall be installed in accordance with the Installation Guidelines published within NEMA FB 2.40.

E. Conduit Termination Fittings

1. Where conduits terminate at enclosures with a NEMA 4, 4X, or 3R rating and the enclosure does not have integral conduit hubs, an appropriately sized watertight

conduit hub shall be installed to maintain the integrity of the enclosure. The use of locknuts with integral gasket in lieu of watertight conduit hubs is not acceptable.

2. Where conduits terminate at enclosures that do not require conduit hubs, a two-locknut system shall be used to secure the conduit to the enclosure. One locknut shall be installed on the outside of the enclosure, and the other inside, drawn tight against the enclosure wall. The locknut on the interior of the enclosure shall be the type with integral bonding lug, or a conduit bonding bushing may be used in place of the interior locknut.

3. Conduits shall not be installed such that conduit fittings penetrate the top of any enclosure located outdoors, except in cases where specifically required by the serving electric utility. Conduits which serve outdoor equipment or an enclosure from above shall instead be routed into the side of the enclosure at the bottom. The conduit termination fitting shall be provided with a conduit drain to divert moisture from the raceway away from the enclosure.

3.05 CONDUIT IDENTIFICATION

A. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:

1. Labels shall consist of an orange background with black text. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.

2. In addition, at the source end of the conduit, a second line of text shall be included to indicate the load equipment name. This second line shall consist of the word “TO:” and the text in the ‘TO’ column of the conduit and wire schedule (e.g. TO: Structure E level transmitter). At the load end of the conduit, a second line of text shall be included to indicate the source equipment name. This second line shall consist of the word “FROM:” and the text in the ‘FROM’ column of the conduit and wire schedule (e.g. FROM: LP-6). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.

3. For conduits trade sizes 3/4 inch through 1-1/2 inch, the text shall be a minimum 18-point font. For conduits trade size 2 inch and larger, the text shall be a minimum 24-point font.

4. Label height shall be 3/4 inch minimum, and length shall be as required to fit required text. The label shall be installed such that the text is parallel with the axis of the conduit. The label shall be oriented such that the text can be read without the use of any special tools or removal of equipment.

5. Labels shall be installed after each conduit is installed and, if applicable, after painting. Labels shall be printed in the field via the use of a portable label printing system. Handwritten labels are not acceptable.

6. Labels shall be made of permanent vinyl with adhesive backing. Labels made of any other material are not acceptable.

B. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:

1. The tag shall be made of white Tyvek material, and have an orange label with black text, as described above, adhered to it. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.

2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.

C. Conduits for lighting and receptacle circuits shall not require identification.

D. Any problems or conflicts with meeting the requirements above shall immediately be brought to the attention of the Engineer for a decision.

3.06 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling rope.

3.07 TRAINING OF INSTALLATION PERSONNEL

A. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract to be considered valid. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit or shall be trained/re-trained as required prior to commencement of conduit installation.

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SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The scope of work under this Section includes furnishing and installing all pull boxes, junction boxes, and outlet boxes.

B. Requirements for other boxes and enclosures are not included in this Section. Reference each specific equipment Section for requirements related to that equipment's respective enclosure.

C. Reference Section 26 05 00 – Basic Electrical Requirements and Section 26 05 33.13 – Conduit for Electrical Systems.

1.02 CODES AND STANDARDS

A. Boxes shall be designed, manufactured, and/or listed to the following standards as applicable:

1. UL 514A – Metallic Outlet Boxes

2. UL 514C – Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers

3. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations

4. UL 50E – Enclosures for Electrical Equipment, Environmental Considerations

5. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

6. NEMA 250 – Enclosures for Electrical Equipment

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:

1. Shop Drawings

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets for boxes, terminal strips, and all accessories

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

1.06 IDENTIFICATION

A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings (e.g. PPB-600, CTJB-600) or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 PULL AND JUNCTION BOXES

A. General

1. All pull and junction boxes shall be UL listed and labeled.

2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.

3. Pull and junction boxes mounted embedded in concrete shall be UL listed for embedment.

4. Where metallic boxes are used, they shall be of all welded construction. Tack welded boxes are not acceptable.

B. Pull Boxes

1. Metallic pull boxes shall be provided with a matching gasketed cover. For covers with dimensions of less than 12 inches by 12 inches, the cover shall be held in place by stainless steel machine screws. Other screw types are not acceptable. For covers with dimensions 12 inches by 12 inches and larger, the cover shall be hinged and held in place by 1/4-turn style latches. Latch mechanism shall be all stainless steel. Hinge pins shall be removable.

2. Non-metallic pull boxes shall be provided with a matching gasketed cover. The cover shall be hinged and held in place by quick-release (e.g. “flip”) latches. Latch material of construction shall match the box material, and include stainless steel hasps. For covers with dimensions 24 inches by 24 inches and larger, a 3-point latching mechanism with external pad-lockable handle may be substituted. Latch mechanism and handle shall be all stainless steel. Hinge pins shall be removable.

3. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.

4. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.

5. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:

    a. Power wiring

    b. AC control wiring

    c. DC control wiring

    d. Instrumentation wiring

C. Junction Boxes

1. Metallic junction boxes shall be provided with a matching gasketed cover. For covers with dimensions of less than 12 inches by 12 inches, the cover shall be

held in place by stainless steel machine screws. Other screw types are not acceptable. For covers with dimensions 12 inches by 12 inches and larger, the cover shall be hinged and held in place by 1/4-turn style latches. Latch mechanism shall be all stainless steel. Hinge pins shall be removable.

2. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:

    a. Power wiring

    b. AC control wiring

    c. DC control wiring

    d. Instrumentation wiring

3. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.

4. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.

5. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Enclosure Type and Material
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

2.03 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Section 26 27 26 – Wiring Devices for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.

2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.

3. Outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Enclosure Type and Material
All Outdoor Areas	NEMA 4X, Cast Aluminum

4. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

C. Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL listed and labeled. Pre-punched single diameter conduit knockouts are acceptable; however, concentric and eccentric knockouts are not acceptable.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.

3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.

4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Section 26 05 33.13 – Conduit for Electrical Systems for conduit hub requirements.

5. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.

3. For the below-named items, mounting heights from finished floor, or finished grade to top is applicable, depending on the type of wiring device to be installed in the outlet box. Mounting heights for outlet boxes shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):

   a. Light switches, 48 inches

   b. Receptacles in outdoor locations, 24 inches

4. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull and junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.

B. The types of electrical identification specified in this Section include, but are not limited to, the following:

1. Operational instructions and warnings.

2. Danger signs.

3. Equipment/system identification signs.

4. Nameplates.

1.02 SIGNS

A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 LETTERING AND GRAPHICS

A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification Section.

1.05 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 NAMEPLATES

A. Nameplates shall be engraved, high pressure plastic laminate, white with black lettering.

B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or equal.

2.03 HIGH VOLTAGE SIGNS

A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

2.04 CONDUIT IDENTIFICATION

A. Conduit identification shall be as specified in Section 26 05 33.13 – Conduit for Electrical Systems.

2.05 WIRE AND CABLE IDENTIFICATION

A. Field installed wire and cable identification shall be as specified in Section 26 05 19 – Low Voltage Conductors and Cable.

B. A plastic laminate nameplate shall be provided at each panelboard, motor control center, switchgear assembly, and switchboard assembly. This nameplate shall be used to clearly convey the conductor identification means used at that piece of equipment (i.e. Phase A=Brown, Phase B=Orange, C = Yellow).

C. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective Section.

2.06 BOX IDENTIFICATION

A. Pull, junction and device box identification shall be as specified in Section 26 05 33.16 – Boxes for Electrical Systems.

PART 3 – EXECUTION

3.01 NAMEPLATES

A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.03 POWER SOURCE IDENTIFICATION

A. After installation of all field equipment (i.e. valves, motors, instruments, etc.) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (panelboard, etc.), circuit number, conduit number from schedule and voltage/phase.

B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.

C. Nameplates shall be as specified herein.

END OF SECTION

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SECTION 26 27 26
WIRING DEVICES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all switches, occupancy sensors, and receptacles as shown on the Drawings.

B. All switches and receptacles shall be furnished and installed in outlet boxes. Reference Section 26 05 33.16 – Boxes for Electrical Systems for outlet box requirements.

C. Reference Section 26 05 00 – Basic Electrical Requirements and Section 26 05 19 – Low-Voltage Conductors and Cables.

1.02 CODES AND STANDARDS

A. Wiring devices shall be designed, manufactured, and/or listed to the following standards as applicable:

1. UL 20 – General Use Snap Switches

2. UL 498 – Standard for Attachment Plugs and Receptacles

3. UL 943 – Ground Fault Circuit Interrupters

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include, but not be limited to:

1. Product data sheets.

1.05 SPARE PARTS

A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.

B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.06 IDENTIFICATION

A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The Contractor shall use the products of a single manufacturer for each type of wiring device.

C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:

1. Where the selected plate manufacturer does not manufacture a suitable finish plate.

2. For heavy-duty receptacles rated at more than 30A.

3. Where non-standard plates are required, specified, or shown.

D. The Contractor shall furnish and install all wiring devices and device plates.

E. In non-hazardous areas, provide specification grade devices manufactured by Appleton, Crouse-Hinds, Leviton, Hubbell, Pass & Seymour, or Engineer approved equal.

2.02 WIRING DEVICES

A. Wall switches shall be rated for the current required to suit the application, but not less than 20A. Double pole, three-way, and four-way switches shall be provided where indicated on the Drawings, and as required. Switches shall be rated for 120-277VAC and shall be UL 20 Listed.

B. Convenience receptacles shall be rated for 20A at 125VAC and shall be UL 498 Listed. Receptacles shall be weather resistant where installed in wet or damp locations.

C. Special purpose receptacles (welders, lab equipment, etc.) shall be provided with the proper NEMA configuration and ampacity as indicated on the Drawings. The coordinating plug for each special purpose receptacle shall be provided with the equipment which it is serving.

D. Ground fault circuit interrupter receptacles shall be rated for 20A at 125VAC and shall be UL 943 Listed. Receptacles shall be weather resistant where installed in wet or damp locations.

E. All wiring devices shall be approved for use with stranded conductors, if stranded conductors are to be used with the device. Reference Section 26 05 19 – Low-Voltage Conductors and Cable for conductor requirements

2.03 DEVICE PLATES

A. Device plates for outdoor installations, indoor wet process areas, and chemical storage/transfer areas shall be Appleton Type FSK, Crouse-Hinds #DS185, or equal for wall switches. Device plates for receptacles shall be “in-use” style. “In-use” weatherproof covers shall be rugged, minimum 3 ¼” depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," Intermatic International, Inc., or equal.

2.04 PLUGS

A. The Contractor shall furnish suitable plugs with equipment furnished under the respective Specification Section. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

2.05 PROCESS INSTRUMENTS

A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument etc.,) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or equal.

2.06 OCCUPANCY SENSORS

A. Occupancy sensors shall be mounted as indicated on the Drawings. Sensors shall be as specified in the fixture schedule on the Drawings and shall be furnished with fixture types where specified in the fixture schedule.

B. Sensors shall be provided with all mounting hardware, control units, and adaptors as required for a complete and operable lighting control system.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Where more than one (1) switch occurs at one (1) location, gang plates shall be used.

B. All device plates shall be set true and plumb and shall fit tightly against the outlet boxes.

C. Wiring device box (outlet box) mounting heights shall be as specified in Section 26 05 33.16 – Boxes for Electrical Systems.

D. When indicated height would place any of the equipment at an unsuitable location, the Contractor shall bring it to the attention of the Engineer for a decision.

E. Ground fault circuit interrupter receptacles shall be furnished and installed where indicated on the Drawings, and as required by the NEC.

F. All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14-point font.

G. The turn-off time delay for each occupancy sensor shall initially be set to 10 minutes. Contractor shall be responsible for the proper commissioning and testing of each occupancy sensor to ensure that it operates to the Owner and Engineer's satisfaction.

3.02 CIRCUITING

A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit, unless otherwise indicated on the Drawings.

END OF SECTION

SECTION 26 50 00
LIGHTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all lighting fixtures, labor, and material, in accordance with the preceding Specifications, the requirements of this Section, and as shown on the Drawings.

B. Lighting shall be in accordance with the latest requirements of the Illuminating Engineering Society.

C. Reference Section 26 05 00 – Basic Electrical Requirements and Section 26 05 26 – Grounding and Bonding for Electrical Systems.

1.02 CODES AND STANDARDS

A. The equipment specified herein shall comply with the following codes and standards, where applicable.

1. Underwriter's Laboratories, Inc. (UL):

a. UL 916 – Standard for Energy Management Equipment

b. UL 1598 – Luminaires

2. American National Standards Institute (ANSI):

a. ANSI C62.41 – Guide for Surge Voltages in Low-Voltage AC Power Circuits

3. National Electrical Code (NEC), latest edition.

B. Where equipment herein is specified as being Listed to a particular UL standard, that equipment shall be tested for compliance with the UL standard by either UL itself, Factory Mutual (FM), or the Canadian Standards Association (CSA). Testing to UL standards by any other testing agencies is not acceptable.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts Lists

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor for resubmittal without review.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Catalog cuts for each fixture type showing performance and construction details of standard fixtures, and complete working drawings showing all proposed construction details of special or modified standard fixtures.

3. Photometric curves.

4. LED data including efficiency (Efficacy lumens/watt) information.

5. LED Driver information

6. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens.

7. Manufacturer’s warranty information

8. Custom wiring diagrams for each individual lighting contactor application. Standard wiring diagrams that are not custom created by the manufacturer for the individual lighting contactors for this project are not acceptable. One wiring diagram which is typical for all lighting contactors is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.

9. System (entire fixture assembly) efficiency data.

10. Pole and foundation calculations.

D. Shop drawings shall be submitted to the Engineer for review and acceptance for all fixtures before fixtures and poles are manufactured. Substitutions will be permitted only if acceptable to the Engineer.

E. Manufacturer's model/series and description in the fixture schedule on the Contract Documents establishes a level of quality, style, finish, etc. The use of a model/series describing the various types of fixtures shall be used as a guide only and does not exclude all the required accessories or hardware that may be required for a complete installation.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit Operation and Maintenance Manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.

1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. The following additional spare parts shall be furnished:

1. A minimum of one (1) LED driver for every ten (10) drivers (of the same type) installed.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 LIGHTING CONTROLS

A. The lighting systems shall be controlled as specified herein and indicated on the Drawings.

1.08 WARRANTY

A. The manufacturer's warranty shall in no event be for a period of less than five (5) years from date of delivery of fixtures to the project site and shall include repair labor, travel

expense necessary for repairs at the jobsite, shipping costs, expendables used during the course of repair, or complete replacement of the failed lighting unit.

B. Warranty for LED fixtures shall be provided for the entire fixture and shall include all parts and accessories. Submittals received without written warranties as specified shall be rejected in their entirety.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The fixture schedule indicates the basis-of-design manufacturer(s) for each fixture type. The Contractor shall submit photometric calculations for each space and/or area where the Contractor wishes to use an equivalent fixture in accordance with Section 26 05 00 – Basic Electrical Requirements. Fixtures will be approved or denied as equivalent on a per-fixture and/or per-space/area basis.

2.02 FIXTURES

A. All lighting fixtures shall be furnished complete with all fittings and hardware necessary for a complete installation. Lighting fixtures shall have all accessories, characteristics, and functionality as specified.

B. Fixture leads shall be as required by NEC. Fixtures shall be grounded by the equipment grounding conductor in the conduit.

C. All glassware shall be high quality, homogeneous in texture, uniform in quality, free from defects, of uniform thickness throughout, and properly annealed. Edges shall be well rounded and free from chips or rough edges.

D. Fixtures specified to be damp or wet locations rated shall be UL 1598 listed.

E. Fixtures shall be as specified in the fixture schedule on the Drawings.

2.03 LED DRIVERS

A. Drivers shall have a voltage range of 347-480V or 120-277 (as required) +/- 10% at a frequency 60Hz.

B. All drivers shall be designed to a power factor >90% with a total harmonic distortion THD <20% at full load.

C. Case temperature shall be rated for -40°C through +80°C.

D. Drivers shall have overheat protection, self-limited short circuit protection and overload protected.

E. Drivers shall be furnished with a fused primary.

F. Drivers shall have an output current ripple <30%

G. Drivers shall be manufactured by Advance, Universal or equal.

H. Drivers shall be UL Listed for damp location, UL1012, UL935, ROHS.

I. Drivers shall meet FCC 47 Sub Part 15.

J. All drivers shall be provided with ANSI/IEEE C62.41 Category C (10kV/5kA) surge protection.

2.04 LEDS

A. Luminaires provided with LED technology shall utilize high brightness LEDs with a group binning code of P and/or Q.

B. Color Temperature: as specified in fixture schedule.

C. Junction point shall be designed and manufactured to allow adequate heat dissipation.

D. LEDs shall be rated for 50,000 hours of life, minimum (based on IESNA L70).

2.05 POLES AND FOUNDATIONS

A. Poles shall be designed to withstand calculated wind force based on wind velocity in accordance with the provisions of the Building Code for the State or Commonwealth in which the project is located.

B. Pole mounted fixtures shall be mounted on poles as designated in the fixture schedule or as indicated on the Drawings. Poles shall have adequate handholes. Furnish and install weatherproof receptacles where indicated. All anchor bolts and nuts shall be hot-dipped galvanized steel.

C. Poles shall be as specified fixture schedule on the Drawings and shall be furnished with fixture types where specified in the fixture schedule.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Lighting fixtures shall be located symmetrically with structure lines as shown on the Drawings. The Contractor shall furnish and install the lighting fixtures to allow

"convenient" access for maintenance. The Contractor shall install fixtures at mounting heights indicated on the Drawings or as instructed by the Engineer. In areas with exposed piping, installation of lighting fixtures shall be adapted to field conditions as determined by the Engineer. Where fixtures are shown in locations on the Drawings where maintenance would be difficult, the Contractor shall notify the Engineer for direction.

B. The Contractor shall provide and install all inserts, conduit, structural supports as required, lamps, ballasts, poles, wiring, and any other items required for a complete system. Contractor shall properly adjust and test, to the satisfaction of the Engineer, the entire lighting system.

C. The Contractor shall protect all fixtures at all times from damage, dirt, dust, and the like. Upon completion of work, and after the area is broom clean, all fixtures shall be made clean and free of dust and all other foreign matter both on visible surfaces, and on surfaces that affect the lighting performance of the fixture including diffusers, lenses, louvers, reflectors, and lamps.

D. All wiring/cables associated with lighting equipment shall be installed in conduits or other raceways as specified. Installing wiring/cables exposed is not acceptable, unless specifically shown otherwise on the Drawings.

E. All lighting fixtures, when installed, shall be set true and be free of light leaks, warps, dents, and other irregularities.

F. The Contractor shall support each fixture securely. The Contractor shall not secure fixtures to the work of other trades, unless specified or noted otherwise. The Contractor shall furnish and install all members and supports as required to fasten fixtures to the structure.

G. In all mechanical equipment areas, the Contractor shall install lighting fixtures after all piping and equipment therein has been installed. Exact locations for such fixtures may be determined by the Engineer on the site during the course of the work.

H. All fixtures that require physical adjustment shall be so adjusted in accordance with the directions of the Engineer. The Contractor shall also adjust angular direction of fixtures and/or lamps, as directed.

I. No special tools shall be required for re-lamping of fixtures. All optical control surfaces such as lenses and reflectors shall be safely and securely attached to fixtures and shall be easily and quickly removed and replaced for cleaning without the use of special tools.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Certified Shop Tests

a. The lighting fixtures shall be given routine factory tests in accordance with the requirement of ANSI, NEMA and Underwriters Laboratories standards.

2. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.

END OF SECTION

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SECTION 31 00 01
EARTHWORK

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, equipment, and materials required to complete all work associated with off-site borrow, fill and backfill placement and compaction, coordination for testing of soil materials and compaction, constructing embankments, dewatering, construction of drainage layers, installing foundation and backfill aggregate, placing filter and separation fabrics, stockpiling topsoil and any excess suitable material, designing, installing, maintaining and removing excavation support systems, disposing of all excess and unsuitable materials, providing erosion and sedimentation control, encasing utility conduits, site grading, preparation of pavement and structure subgrades, and other related and incidental work as required to complete the work shown on the Drawings and as specified herein.

B. It is the intent of this Specification that the Contractor conduct the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized. Erosion control for the Project shall be performed in accordance with the Contract Drawings and Section 31 25 00 – Erosion and Sedimentation Controls.

C. All fill materials (soil, aggregate, topsoil, etc.) imported to the site and onsite materials to be reused as fill, backfill, embankment, etc. shall be subjected to the testing requirements contained in Part 3.0 of this Section. The Contractor shall retain a Materials Testing Consultant approved by the Engineer who shall perform all testing. The test results shall be used to determine if a material meets the requirements included herein. The Contractor shall furnish all necessary samples for laboratory testing and shall provide assistance and cooperation during field tests. The Contractor shall plan their operations to allow adequate time for laboratory tests and to permit taking of field density tests during compaction.

D. Any costs for re-testing required as a result of failure to meet compaction requirements shall be borne solely by the Contractor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Divisions 01, 02, 31, and 32 of these Specifications, including but not limited to:

I. Section 02 41 16 Demolition and Removal of Existing Structures and Equipment

II. Section 31 00 02 Excavation

III. Section 31 05 16 Aggregate Materials

IV. Section 31 05 19 Geotextiles

V. Section 31 10 00 Clearing, Grubbing, and Site Preparation

VI. Section 31 23 19 Dewatering and Water Control

VII. Section 31 25 00 Erosion and Sedimentation Control

VIII. Section 31 35 00 Slope Protection

IX. Section 32 90 00 Final Grading and Landscaping

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.

I. Occupational Safety and Health Administration (OSHA) 29 CFR 1926 Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations, and to the State of Georgia requirements, the more stringent requirement shall apply.

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

a. ASTM C127 – Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.

b. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

c. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3))

d. ASTM D1140 – Standard Test Method for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing

e. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand Cone Method.

f. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/lb^3 (2,700 kN-m/m^3)).

g. ASTM D1883 – Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils.

h. ASTM D2216 – Test for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

i. ASTM D2487 – Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

j. ASTM D4253 – Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

k. ASTM D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

l. ASTM D5268-22 - Standard Specification for Topsoil Used for Landscaping and Construction Purposes

m. ASTM D6913 - Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

n. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth).

1.04 QUALITY CONTROL

A. No earthwork shall be performed unless the Engineer or their representative responsible for quality control of the earthwork is on site.

B. No earth fill material shall be placed until the exposed subgrade is evaluated and approved by the Engineer.

1.05 SUBSURFACE CONDITIONS

A. Information on subsurface conditions is referenced under Division 01, General Requirements.

B. Attention is directed to the possible location of water pipes, sanitary pipes, storm drains, and other utilities located in the area of proposed excavation. In the event excavation activities disrupt service, the Contractor shall perform all repairs at no additional cost to the Owner. The Contractor shall contact Georgia811.com or their professional Georgia 811 liaison to request underground utility location mark-out at least three (3) working days, not including the day the request is called in, but no more than ten (10) working days prior to the beginning of excavation. The Contractor shall also contact and request utility location mark-out from buried utility owners with utilities on the project site that are not participants of Georgia811.com. The Contractor shall coordinate with CCMWA and private utility locate contractors for verification of utilities outside public right-of-ways.

1.06 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following:

I. Evidence the Contractor has a minimum of five (5) years of experience performing earthwork including material handling and processing, general fill placement, and structure backfill placement as part of embankment dam and general earthwork type projects of similar size and complexity to the work for this project.

II. Name and location of all material suppliers.

III. Certificate of compliance with the standards specified herein for each source of each material.

IV. Pre-construction condition inspection and monitoring plan with documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems, near areas where subsurface dewatering is required to facilitate construction in the dry, and along haul routes within WTP boundaries.

V. A representative sample of the on-site or off-site source of each class of earth fill material weighing approximately 60 lbs. The sample shall be delivered to a location designated by the Engineer.

1.07 PRODUCT HANDLING

A. Soil and rock material shall be excavated, transported, placed, and stored in a manner so as to prevent contamination, segregation, and excessive wetting. Materials which have become contaminated or segregated will not be permitted in the performance of the work and shall be removed from the site.

1.08 USE OF EXPLOSIVES

A. The use of explosives will not be allowed for this work.

PART 2 – PRODUCTS

2.01 EARTH FILL MATERIALS

A. The contractor shall be responsible for providing earth fill materials meeting the gradation requirements included herein.

B. All earth fill materials shall be free of organic material, environmental contaminants, snow, ice, frozen soil, or other unsuitable material.

C. When the excavated material from required excavations meets the requirements of Select Fill or Common Fill, but is replaced with off-site borrow material for the

Contractor's convenience, the costs associated with such work and material shall be borne by the Contractor.

D. Where excavated material does not meet requirements for Select Fill or Common Fill, the Contractor shall furnish off-site borrow material meeting the specified requirements herein. Determination of whether the borrow material will be paid for as an extra cost will be made based on the contract documents.

E. Contractor may stockpile excavated material to be used as Select Fill, Common Fill, or Topsoil on site in areas designated in the Contract Documents. Soil materials may be stockpiled as necessary to sort, segregate, test, and transfer the materials. Excess material and materials considered unsuitable for reuse by the Engineer shall be removed from the site for off-site disposal. No stockpiling of excavated material is allowed in a manner or location that would permit erosion and its subsequent sedimentation in wetlands or other natural areas.

F. All earth fill materials shall be fine, sound, loose earth containing specified moisture content range for compaction to at least 95 percent of the soil's Standard Proctor maximum dry density, or as noted on the Drawings. The upper two feet beneath pavements shall be compacted to at least 98 percent.

G. All earth fill materials shall have a maximum dry density (ASTM D-698) of at least 95 pounds per cubic foot unless specifically approved otherwise by the Engineer.

H. All materials used as Earth Fill materials are subject to approval by the Engineer.

I. All imported earth fill materials must be pre-approved by the Engineer before delivery to the project. Contractor to allow 4 weeks for sampling and laboratory testing for approval by Engineer.

2.02 SELECT FILL

A. Select fill is earth fill material that shall be used where shown on the Contract Drawings, to backfill all below-grade walls, and within the limits of the reservoir embankment and reservoir interior to repair and/or restore the slopes, bottom, and clay blanket (reservoir liner) and backfill around structures.

B. All Select Fill materials required to repair and/or restore the reservoir embankment and reservoir interior slopes, bottom, and clay blanket (reservoir liner) are to be imported. No excess borrow materials are available on site.

C. Excavated earth embankment soils around bridge structures and bypass and drain pipelines within the dam embankment shall be moisture conditioned and reused within the same area of work provided the excavated material meets the requirements of Select Fill.

D. Select fill shall fall within the requirements of Unified Soil Classification System (USCS) soil types CL and SC. SC materials shall have at least 35% passing the #200 sieve (ASTM D422) and a PI of at least 15 (ASTM D423/D424).

E. Select fill shall not include particles, lumps, or rocks larger than 2 inches. Select fill used inside the reservoir for clay blanket fill or to repair and/or restore the clay blanket reservoir liner shall be free of particles, lumps, or rocks larger than 1 inch.

F. Select Fill shall be compacted at a moisture content at or above the optimum moisture content of the fill material in accordance with the ASTM D 698, Standard Proctor.

2.03 COMMON FILL

A. Common fill is earth fill material that shall be used where shown on the Contract Drawings, outside the limits of the reservoir embankment, and to construct the permanent access ramp.

B. All Common Fill materials required to build the permanent access ramp are to be imported. No excess borrow materials are available on site.

C. Excavated earth soils around the bypass and drain pipelines outside of the dam embankment shall be moisture conditioned and reused within the same area of work provided the excavated material meets the requirements of Common Fill.

D. Common fill shall fall within the requirements of USCS soil types CL, SC, ML, and SM soils. SM soils shall have a minimum of 15% passing the #200 sieve (ASTM D422) and a PI of at least 6 (ASTM D423/D424).

E. Common fill shall not include particles, lumps, or rocks larger than 2 inches.

F. Common Fill shall be compacted at a moisture content within +/- 2 percent of the optimum moisture content of the fill material in accordance with the ASTM D 698, Standard Proctor.

G. Select Fill may be used as Common Fill, subject to approval by the Engineer. Select fill may be used as Common Fill at no change in the Contract Price.

2.04 CONCRETE BACKFILL

A. Concrete and/or grout backfill shall be 3000 psi regular weight, unless otherwise noted.

2.05 TOPSOIL

A. Dark organic weed free loam, free of muck and weeds; excavated from the site or imported as needed.

2.06 GEOTEXTILES

A. The Contractor shall provide geotextiles as indicated on the Contract Drawings and specified herein. The materials and placement shall be as indicated under Section 31 05 19 - Geotextiles.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Site datum is local and specific to the water plant site. See Drawings for information.

B. The elevations shown on the drawings as existing are taken from the best available data and are intended to give reasonable, accurate information about the existing elevations. If the information is not precise, the Contractor should satisfy himself as to the exact quantities of excavation and earth fill required.

C. Verify that survey benchmark and intended elevations for the Work are as indicated.

D. Identify required lines, levels, contours, and datum.

E. Stake and flag locations of known utilities.

F. Locate, identify, and protect utilities that remain from damage.

G. Protect plant life, lawns, and other features remaining.

3.02 PREPARATION

A. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926 Safety and Health Regulations for Construction.

B. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.

C. All excavated and filled areas for structures, trenches, earth fills, topsoil areas, embankments and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the Engineer and Owner. All damage caused by erosion or other construction operations shall be repaired by the Contractor using material of the same type as the damaged material.

D. The Contractor shall control grading in a manner to prevent water running into excavations.

E. Locate, identify, and protect utilities that remain from damage.

F. The Contractor shall exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, buildings, buried utilities, asphalt pavements and other structures which are located in the construction area but not within designated clearing limits as shown on the Drawings or within the limits of embankments, excavations, or proposed structures. The Contractor shall be responsible for the repair and/or replacement of any of the aforementioned items damaged by his operation or construction activities.

3.03 STRIPPING

A. Remove all topsoil to a depth at which suitable subsoil is encountered from all areas which are to be cut to lower grades, to received earth fill, under structures and where required for the construction of the dam or as recommended by the Engineer.

B. Stripping shall be carried out to a depth and extent recommended by the Engineer.

C. Stripped material must be disposed of in one of the following manners as selected by the Contractor and approved by the Engineer:

I. Stockpiled for later use as topsoil.

II. All excess stripped material shall be hauled from the site and disposed of by the Contractor. The Contractor is responsible for obtaining all necessary owner and jurisdictional/regulatory permits and permissions for haul off and disposal of excess materials.

3.04 OFF-SITE BORROW SOURCE/EXCAVATION

A. At least four (4) weeks prior to beginning earthwork activities requiring the import of borrowed earth fill materials, the contractor shall submit their borrow site address, pertinent borrow (land) owner information, obtain permission for entrance, and provide suitable equipment and operator to perform test pit excavations and sampling under the supervision of the Engineer. Samples collected will be subjected to laboratory testing for final acceptance for this project.

B. The Engineer shall designate the depths of cut and areas to be excavated within the borrow areas that will result in the best gradation of earth fill materials. The Engineer reserves the right to change the limits or location of soils excavated from the borrow area for use in the embankment in order to obtain the most suitable material.

C. The Contractor will be required to excavate sufficient suitable material from the borrow areas to complete the work covered by these documents regardless of whether overly wet conditions encountered are due to groundwater, precipitation, difficulty in draining or any other reason.

D. All cut areas where soils are excavated shall be maintained to provide surface drainage and prevent ponding of surface water.

E. Wherever the placement of earth fill requires material not available at the site or material in excess of suitable material available from the authorized excavations, such materials shall be obtained from other sources. This may require the opening of an off-site borrow pit(s) or borrowing from a commercial site. In such cases, the Contractor shall make suitable arrangements with the property owner and shall pay all costs incident to the borrowed material. The Contractor shall obtain all permissions and permits to meet jurisdictional/regulatory requirements for land disturbance, excavation, hauling and erosion and sediment control.

F. Before any off-site borrow materials are transported to the site, the quality and suitability of the material to be obtained shall be approved by the Engineer.

G. The Contractor shall be entitled to no additional allowance on account of the requirement for excavating drainage ditches; for allowing additional time for drying; for stockpiling and re-handling excavated materials which have been deposited temporarily in stockpiles; delays or increased costs due to stockpiling; poor trafficability in the borrow area, the haul roads or the embankment; reduced efficiency of the equipment the Contractor elects to use; or on account of any other operations or difficulties caused by overly wet materials.

3.05 BACKFILL

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place.

C. Where appropriate, proofroll subgrade surface to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent earth fill material.

D. Backfill with approved earth fill material and compact to density equal to or greater than requirements for subsequent earth fill material.

3.06 BACKFILLING STRUCTURES

A. No backfill shall be placed against concrete structures until the concrete has reached its specified 28-day compressive strength.

B. Verify structural ability of unsupported walls to support loads imposed by the earth fill.

C. Heavy equipment or rollers shall not be operated within 5 feet of any structure or pipe, or at a distance required to prevent damage to the structure.

3.07 EARTH FILL

A. Placement of earth fill materials for the dam embankment, permanent access ramp, reservoir slopes and bottom, pipe backfill within limits of embankment and foundation shall be as directed on the drawings.

B. Only Unified Soil Classification System materials indicated on the Drawings or in Sections 2.01, 2.02 and 2.03 can be used as earth fill materials, unless specifically approved in writing by the Engineer.

C. Horizontally bench existing slopes steeper than 5H:1V to key placed earth fill material to slope and to provide firm bearing.

D. Fill areas to contours and elevations indicated on the drawings.

E. Earth fill material for embankments shall be compacted by rolling with self-propelled or water filled towed sheepsfoot rollers, knobby-footed vibratory rollers, or other approved compaction equipment in good working order, as required to accomplish the work.

F. The use of trucks, carryalls, scrapers, tractors, or other heavy hauling equipment shall not be considered as rolling in lieu of appropriate compaction equipment, but the traffic of such hauling equipment shall be distributed over the earth fill in such a manner as to make the use of the compaction afforded thereby as an addition to compaction by the use of approved rollers.

G. The earth fill is to be constructed as shown on the drawings or specified herein. The selective classification and use of earth fill materials shall be made through cooperation between the Contractor and the Engineer by varying the location and limits of soils excavated from the approved borrow areas as the work progresses.

H. The distribution and gradation of materials throughout the earth fill shall be such that it will be free from lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material so that field control of moisture and density may be based upon a known type of material.

I. The Engineer or his representative shall make final determination of the classification of any material as suitable or unsuitable.

J. If the exposed subgrade becomes overly dry or overly wet during breaks in the grading operation it will become necessary to blade off, or scarify and re-compact these materials in place after appropriate moisture adjustment prior to the addition of subsequent layers.

K. Each layer of earth fill placed shall have a maximum 6 to 8 inches loose depth prior to compaction. Thinner lifts will be required in confined areas and/or where light, portable compaction equipment is utilized.

L. If the methods used to excavate and transport the earth fill material results in clods of earth when spread larger than those specified, the Contractor shall pulverize the material to break down these clods to the specified sizes, and uniformly blend these materials to evenly distribute the lumps remaining, by methods approved by and to the satisfaction of the Engineer, before compaction.

M. No frozen materials shall be placed as earth fill, nor shall subsequent earth fill be placed upon frozen material.

N. Should a smooth condition occur between lifts, lightly scarify the exposed surface to a depth of not less than 3 inches to assure adequate bonding with the overlying lift using gang disks, specified compaction equipment, or other techniques approved by the Engineer.

O. The top surfaces of the earth fill shall be maintained approximately level during construction, except that a crown or cross-slope of not less than 2 percent shall be maintained to ensure effective drainage.

P. All earth fill lifts shall be graded to prevent surface water ponding.

Q. The surface of all earth fills shall be sealed at the end of each workday by proofrolling with rubber-tired or smooth drum rollers. Sealed surfaces will require reworking as specified to provide a satisfactory bonding surface prior to placing the next earth fill layer.

R. Each load of the material placed as earth fill shall be placed in the location designated by the Engineer. The Contractor shall be entitled to no additional allowance on account of this requirement.

S. Each layer of earth fill shall be constructed continuously and approximately horizontal for the width and length of such portion at the elevation of the layer. The intention is to maintain the level of earth fill within the fill zone at approximately the same elevation throughout the section at any point in time to the extent possible. Sloping finished grades shall be overfilled and trimmed to designed elevations and surfaces. No earth fill shall be placed on sloping surfaces unless approved by the Engineer.

T. Where earth fill is placed adjacent to conduits or structures, maintain the level of earth fill approximately equal on all sides. In addition, thinner earth fill lifts and portable compaction equipment such as hand tamps will be required.

U. It is the Contractor’s responsibility to place earth fill and achieve compaction without damage to other structures.

V. Make grade changes gradual. Blend slopes into level areas.

3.08 CONTROL OF MOISTURE CONTENT AND COMPACTION

A. During the placement and compaction of earth fill, the material in each layer of the fill placed shall have the moisture content specified.

B. The moisture content shall be uniform throughout the layer. This shall be accomplished by sprinkling water on the material in place on the embankment and/or at the site of excavation, and disking or otherwise manipulating the material to evenly distribute the moisture prior to compaction.

C. The Contractor shall maintain a water truck or wagon and farm tractor-type gang disks on site, in good operating order, at all times during earth fill placement.

D. For materials with excessive or non-uniform moisture content, harrowing, disking, or other reworking of the material may be necessary.

E. Select Fill shall be compacted at a moisture content at or above the optimum moisture content of the fill material in accordance with the ASTM D 698, Standard Proctor. Common Fill shall be compacted at a moisture content within +/- 2 percent of the optimum moisture content of the fill material in accordance with the ASTM D 698, Standard Proctor.

F. All earth fill shall be compacted by rolling to at least 95 percent of the standard proctor maximum dry density as determined by ASTM D698. The upper two feet beneath pavements shall be compacted to at least 98 percent.

G. Earth fill placed at densities lower than the specified minimum or at moisture contents outside the specified acceptable range or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements prior to placing additional earth fill, or removed and replaced by acceptable earth fill.

3.09 FINAL GRADING

A. After other earthwork operations have been completed, the sites of all structures and embankments shall be graded within the limits and to the elevations shown on the Drawings. Grading operations shall be so conducted that materials shall not be removed or loosened beyond the required limits.

B. Placement and compaction of materials shall extend beyond the final contours sufficiently to insure compaction of the material at the resulting final surface. Final contours to be grassed shall then be achieved with a tracked bulldozer shaping and compacting the sloped faces of the embankment.

C. All finished surfaces shall be left in smooth and uniform planes such as are normally obtainable from the use of hand tools. If the Contractor is able to obtain the required degree of evenness by means of mechanical equipment he will not be required to use hand labor methods.

D. Slopes and ditches shall be neatly trimmed and finished to slopes shown on the Drawings.

E. All finished ground surfaces and slopes shall be graded and dressed to present a surface varying not more than plus or minus 0.10 foot with respect to local humps or depressions.

3.10 FIELD QUALITY CONTROL

A. Laboratory Compaction Testing in accordance with ASTM D698.

B. Field Density Testing in accordance with ASTM D2937, density of soil in place by the drive-cylinder method, or ASTM D1556, density of soil in place by the sand cone method.

C. Soil Classification Testing in accordance with ASTM D422, ASTM D423 and ASTM D424.

D. In the event of any dispute, the results obtained by the sand cone method, as described in ASTM D1556 shall govern.

E. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

F. The frequency of field density tests will be determined by the Engineer based on the nature of the structure being tested, the character of the soil, and the uniformity of the compaction effort applied by the Contractor. For general earth fill, typically, one density test shall be performed for each 5,000 square feet of area and for each two vertical feet of fill placed. For trench or pipe earth fill, one density test should be performed per 50 linear feet per 2 feet of vertical feet of fill placed.

G. The Contractor will be responsible for notifying the Engineer when specific, previously agreed-upon quantities of earth fill have been placed or when certain, previously agreed-upon elevations have been obtained.

3.11 TOPSOIL

A. All areas to be planted with grass shall be prepared by grading to a smooth, even surface to a level 4 inches below the elevation of the finished grade. It shall then be brought to a neat and finished grade by the addition of 4 inches of approved topsoil.

B. Topsoil removed from the construction area may be stockpiled and reused or topsoil may be obtained from approved borrow areas.

3.12 SETTLEMENT AND EROSION DAMAGE

A. The Contractor shall be responsible for all settlement and erosion damage of backfill, earth fills, and embankments that may occur within one (1) year after final acceptance of the work by the Owner.

B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement or erosion damage within 30 days after receipt of written notice from the Engineer or Owner.

3.13 PROTECTION OF SUBGRADE

A. To minimize the disturbance of bearing materials and provide a firm foundation, the Contractor shall comply with the following requirements:

I. Use of heavy rubber tired construction equipment and some tracked equipment shall not be permitted on the final subgrade unless it can be demonstrated that drawdown of surface water and/or groundwater throughout the entire area of the structure is sufficient to prevent rutting damage to the exposed subgrades. Even then, the use of such equipment shall be prohibited should subgrade disturbance result from concentrated wheel or track loads.

II. Subgrade soils disturbed through the operations of the Contractor shall be excavated and replaced with compacted select fill or crushed stone at the Contractor's expense as indicated by the Engineer.

III. The Contractor shall provide positive protection against penetration of frost into materials below the bearing level during work in winter months. This protection can consist of a temporary blanket of straw or salt hay covered with a plastic membrane or other acceptable means.

3.14 PROOF-ROLLING

A. The subgrade of all areas that will support pavements or new earth fill shall be proofrolled by the Contractor in the presence of the Engineer or designated representative. After stripping of topsoil, excavation to subgrade and prior to placement of earth fills, the exposed subgrade shall be carefully inspected by probing and testing as needed. Any topsoil or other organic material still in place, frozen, wet, soft, or loose soil, and other undesirable materials shall be removed. The exposed subgrade shall be proof-rolled with a heavily loaded tandem-wheeled dump truck to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed shall be removed and replaced with an approved compacted material, as directed by the Engineer.

END OF SECTION

SECTION 31 00 02
EXCAVATION

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The work described in this Section pertains to all excavations, including foundations, appurtenant structures and facilities, piping, slope protection and removal of sediments as required for the performance of this Contract. The Contractor shall provide all supervision, labor, materials, equipment, tools, instruments and supplies required for the completion of earthwork and slope protection in accordance with these Specifications and Contract Drawings.

B. It is the intent of this Specification that the Contractor conduct the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized. Erosion control for the Project shall be performed in accordance with the Contract Drawings and Section 31 25 00 – Erosion and Sedimentation Controls.

C. Following initial removal of reservoir water by CCMWA, the Contractor shall be responsible for removal of all remaining water, dewatering, and water control measures within the limits of construction in accordance with Section 31 23 19 Dewatering/Water Control.

D. The Contractor will take all necessary precautions to prevent damage to otherwise suitable foundation materials, the clay blanket (reservoir liner), and structures for the specified construction. Any damages caused by the Contractor or his subcontractors shall be repaired to the satisfaction of the Engineer at no additional cost to the Owner.

E. The work shall include but not be limited to:

1. After stripping operations are complete, excavate and/or rework existing approved soil materials to depths indicated on the Contract Drawings and as required for construction of new structures, embankments, installation of new and repair of existing clay blanket (liner) and fabric-formed concrete slope protection, pavements, and pipelines. Remove all debris, organics and any materials unsuitable for planned construction. Dispose of unsuitable materials offsite. The Contractor shall not perform unauthorized excavations into and below the clay blanket liner within the reservoir interior for any purposes unless approved by the Engineer.

2. Excavate, moisture condition, remove and dispose of all alluvial sediment materials from within the reservoir limits. Caution should be exercised to not over-excavate the reservoir interior and cause damage to or diminish the thickness of the clay blanket (liner).

3. Dewater and maintain appropriate surface drainage and sub-strata drainage to accomplish all excavation and earthwork activities, including but not limited to, undercutting, proof rolling, excavations, fill placement and any other construction activity required to complete this project without causing disturbance of underlying or surrounding soils and structures.

4. Perform pre-construction condition inspection and monitoring plan with documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems, near areas where subsurface dewatering is required to facilitate construction in the dry, and along haul routes within WTP boundaries.

5. Provide construction drawings and structural calculations for any types of excavation support required. Drawings and calculations shall be sealed by a currently registered Professional Engineer in the State of Georgia.

6. Submit excavation support installer qualifications with installation history.

7. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer. In cases where excavation limits are not provided, the Contractor shall be required to submit plans and cross sections of the open cut excavation showing side slopes and limits of the excavation at grade for review by the Engineer before approval is given to proceed.

8. Dispose of all excavated materials which are not used or are unsuitable for use in the construction in offsite disposal areas. Excavated materials that are deemed unsuitable for, or are in excess of, embankment or other earthwork requirements, as determined by the Engineer, shall be hauled from the site and disposed of by the Contractor at off-site locations arranged by the Contractor. All aspects of all off-site disposal areas, including loading, hauling, dumping and spreading, will be coordinated between the Contractor and the off-site property owner and shall be performed in a manner that meets all applicable laws and regulation pertaining thereto.

9. Provide required submittals.

10. Perform all surveys and grade staking necessary to verify excavation elevations and limits as indicated on the Contract Drawings.

1.02 QUALITY CONTROL

A. No excavation shall be performed unless the Engineer or their representative responsible for quality control of the earthwork is on site.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Divisions 01, 02, 31, and 32 of these Specifications, including but not limited to:

1. Section 02 41 16 – Demolition and Removal of Existing Structures and Equipment

2. Section 31 00 01 – Earthwork

3. Section 31 10 00 – Clearing, Grubbing, and Site Preparation

4. Section 31 23 19 – Dewatering and Water Control

5. Section 31 25 00 – Erosion and Sedimentation Control

1.04 SUBMITTALS

A. The Contractor shall prepare and submit to the Engineer for approval all necessary data and certifications listed below:

1. Construction Equipment - Submit descriptive information on excavation equipment to be used for construction. The data shall include type of equipment, manufacturer, model number, axle weights, tire inflation pressure, and other descriptive information. Also submit descriptive information on proposed earth moving equipment and a schedule for the work.

2. Pre-construction condition inspection and monitoring plan with documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems, near areas where subsurface dewatering is required to facilitate construction in the dry, and along haul routes within WTP boundaries.

3. Construction drawings and structural calculations for any types of excavation support required. Drawings and calculations shall be sealed by a currently registered Professional Engineer in the State of Georgia.

4. Excavation support installer qualifications with installation history.

5. Plans and cross sections of any open cut excavation showing side slopes and limits of the excavation at grade.

6. Dewatering procedures in accordance with Section 31 23 19 Dewatering and Water Control.

1.05 PRODUCT HANDLING

A. Existing earth embankment and earth fill materials around structures and along the bypass and drain pipe alignments are intended to be reused as directed by the Engineer unless deemed unsuitable. Soil materials intended for reuse shall be excavated,

transported, placed, and stored in a manner so as to prevent contamination, segregation and excessive wetting. Materials which have become contaminated or segregated will not be permitted in the performance of the work and shall be removed from the site.

B. Soils, sediments and other materials not intended for reuse as new fill or deemed otherwise unsuitable by the Engineer within the limits of construction shall be excavated, moisture conditioned as needed, stockpiled and removed from the site in a manner to not interfere with subsequent work or cause damage to underlying subgrades or contamination of haul routes.

C. Only designated laydown areas and haul routes outside the reservoir bottom footprint may be used for product handling and storage of materials.

PART 2 – EXECUTION

2.01 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain from damage.

C. Protect benchmarks and survey control points, from excavating equipment and vehicular traffic.

D. Following initial reservoir draining by CCMWA and reservoir dewatering by the Contractor, all exposed surfaces within the reservoir interior below the embankment crest will be surveyed by the Engineer (pre-excavation survey) to determine the volumetric quantity of materials to be removed and disposed offsite by the Contractor. See Section 2.04.

2.02 EXCAVATIONS

A. All excavations shall be barricaded in such a manner as to prevent persons from falling or walking into any excavation.

B. Excavations shall provide adequate working space and clearances for the work to be performed therein.

C. Contractor shall notify the Engineer of unexpected subsurface conditions and discontinue work in affected area until notified to resume work.

D. Contractor shall assume responsibility for design and construction of any necessary excavation shoring and bracing capable of supporting excavations and construction loads. Materials and methods selected shall be Contractor's option and responsibility.

E. Unless otherwise stated or approved in advance by the Engineer, all excavations within the limits of the reservoir and earthen embankment shall be configured with 1.5(H):1(V)

or flatter slopes. Excavations for pipe installation outside the limits of the embankment may use safe alternative means and methods acceptable to the Engineer.

F. During excavation operations, the contractor shall take all means and methods needed to control free water within the limits of construction and prevent damage to exposed or final subgrades, clay blanket (reservoir liner), or foundations supporting structures.

G. Excavations shall be made to the lines, grades, and dimensions shown on the drawings or established by the Engineer.

H. All excavations shall be evaluated and approved by the Engineer prior to placement of earth fill, concrete or other fill materials.

I. Remove lumped subsoil and other debris larger than 3 inches in diameter.

J. Slope banks with machine.

K. Grade top perimeter of excavation to prevent surface water from draining into excavation.

L. Hand trim excavation as necessary and remove loose matter.

M. Contractor shall provide and maintain on site at all times during excavation a straight edge blade attachment or straight edge backhoe bucket for the excavator used to perform excavation in the various areas of construction. This equipment shall be used for all final excavation and cleanup of exposed subgrades in areas where a small tracked bulldozer is not able to operate without damaging the otherwise suitable subgrade.

N. Unsuitable material must be removed from beneath planned fill areas to expose the suitable earth fill and/or undisturbed residual materials that will act as the subgrade for new earth fill or other planned construction.

O. Where unstable soil, soft clay, spongy, swampy or other unsuitable materials for subgrade or foundation purposes are encountered below the excavation limits, they shall be removed to the level of suitable material and disposed of offsite, unless materials can be made suitable. Areas so excavated shall be backfilled as directed by the Engineer with either approved earth fill, 3000 psi Class concrete, or with compacted layers of crushed rock, sand, or other approved material conforming to the specific requirements for the backfill to the lines and grades shown on the Drawings. The type of material used for backfill shall be specified and approved by the Engineer.

P. The Engineer will determine actual limits for removal of the unsuitable material. No unauthorized excavation shall be performed.

Q. A dewatering and/or surface water control system may be required during excavation procedures to allow for dry surfaces on which initial and subsequent fill or subsequent construction may be placed.

R. Correct deficient and/or areas over excavated as directed by the Engineer and in accordance with Section 31 00 01 Earthwork.

S. All soil and rock shall be removed from required excavations to the limits and elevations shown on the Contract Drawings. All necessary precautions shall be taken to preserve, in an undisturbed condition, all material below and beyond the designated limits and elevations of required excavations. All material disturbed or loosened beyond the excavation limits shall be removed by the Contractor. Such excavations and other excavations made for the Contractor's convenience beyond the limits and elevations indicated on the Contract Drawings shall be refilled and restored. Concrete shall be used as refill for surfaces against which concrete is to be placed. Restoration shall entail refilling level to adjacent unaffected areas and meeting specified material designation and compaction criteria.

T. Dewatering and proper drainage within excavation areas to allow proper earth moving operations shall be the responsibility of the Contractor. Dewatering/control of water from within the reservoir during sediment removal and other construction should be anticipated. Dewatering and water control shall be performed in accordance with Section 31 23 19 Dewatering and Water Control.

U. Required excavations shall be stripped of all topsoil, brush, roots, debris and organic materials to a clean exposure of the underlying inorganic soils. Material shall be excavated so as to separate it into material types. Required excavation shall be coordinated by the Contractor in such a manner that materials appropriate or necessary for construction are available for immediate placing within the limits indicated.

2.03 EXCAVATED MATERIALS

A. So far as practicable, as determined by the Engineer, all suitable materials from embankment and pipeline excavations for specified permanent construction shall be re-used in the permanent construction required under these specifications. Moisture conditioning of materials may be required to achieve required compaction.

B. Excavated materials that are deemed unsuitable for, or are in excess of, embankment or other earthwork requirements, as determined by the Engineer, shall be hauled from the site and disposed of by the Contractor at off-site locations arranged by the Contractor. All aspects of any and all off-site disposal areas will be coordinated between the Contractor and the off-site property owner and shall be performed in a manner that meets all applicable laws and regulation pertaining thereto.

C. Where practicable, as determined by the Engineer, suitable materials shall be excavated separately from the materials to be wasted and the suitable materials shall be segregated by loads during the excavation operations. The suitable materials shall be placed in the designated final locations directly from the excavation, or shall be placed in temporary stockpiles and later placed in the designated locations as recommended by the Engineer.

D. In excavating materials that are suitable for re-use in the construction, the Engineer will designate the depths of cut that will result in the best gradation of materials, and the cuts shall be made to such designated depths.

E. Excavated materials which, after drainage or drying, are suitable for use as earth fill but which, when excavated, are too wet for immediate compaction shall be placed in temporarily stockpiles until the moisture content is reduced sufficiently to permit them to be placed in the embankment, or may be placed on the embankment subject to the provisions of Section 31 00 01 relative to materials in which the moisture content is greater than that required for proper compaction.

F. Should hard particles having maximum dimensions of more than 2 inches be found in otherwise approved earth fill materials, they shall be removed by the Contractor either at the site of the excavation or after being transported to the area of fill placement, but before the materials are compacted. Such materials shall be wasted. Earth fill materials used to repair and/restore the clay blanket (reservoir liner) shall be free of lumps or rocks larger than 1 inch.

2.04 REMOVAL OF RESERVOIR SEDIMENT MATERIALS

A. Sediment shall be defined as all materials present within the limits of the Raw Water Reservoir below elevation 1050.5 feet, existing above the higher of the clay blanket liner, reservoir bottom, designed 3(h):1(v) earth slopes, and fabric formed concrete slope protection. Sediment materials may include alluvial soils, vegetation, organics, and other debris found within the limits of the reservoir. Sediment materials to be removed have varying engineering properties, consistency, and thickness. Sediments deposited in the reservoir originated by pumped water from the Chattahoochee River to the reservoir or have eroded from the embankment slopes. Sediments contain properties of diluted backwash water from the WTP processes.

B. Sediments have been determined to not require disposal in Subtitle D Landfill facilities. CCMWA encourages disposal of sediment materials by potential beneficial re-use options over landfilling options. Refer to Hazen Technical Memorandum entitled James E. Quarles WTP Raw Water Reservoir Sediment Removal project, dated January 7, 2022. Contractor is responsible for all coordination, facility agreements, expenses, and permits for hauling and disposal.

C. Excavation in the reservoir shall be performed and will consist of the removal of all sediment materials to expose the fabric formed concrete slope protection, and clay blanket liner on the earth slopes below the slope protection and reservoir bottom. Additional excavation below designed reservoir bottom and slope grades may be required to remove sediments and/or water softened soil materials underlying and supporting new construction. All additional excavation will be directed by the Engineer as needed.

D. The reservoir will be initially drained by CCMWA of all free standing water above current sediment levels through WTP structures and processes. CCMWA will cease reservoir

draining when sediment transport into Outlet structures is detected or until movement of water stops. Removal of any remaining free standing or seeping water above the sediment level will be the responsibility of the Contractor. Refer to 31 23 19 Dewatering and Water Control.

E. Prior to sediment removal and at least 7 days following initial draining of the reservoir by CCMWA and at least 7 days after removal of all free standing water by pumping, trenching, and/or other methods by the Contractor, the Engineer will perform a physical topographic survey of the reservoir interior below the embankment crest, including exposed sediment, structures and reservoir surfaces for the basis of determining the volumetric quantity of sediment removal. The determined sediment quantity will become the basis for Unit Pay items within the Contract.

F. All sediments are to be removed and disposed of in offsite facilities determined and coordinated by the Contractor. Sediments are generally classified as “unsuitable materials” and should not be used as engineered structural fill materials or for support of settlement sensitive structures.

G. All sediment materials shall be excavated using conventional earthmoving equipment and processes. All sediment materials shall be moisture conditioning/dried using mechanical manipulation or other acceptable means to remove excess free water and achieve specific disposal facility moisture requirements before loading and transporting over WTP and public roadways. Each disposal facility may have specific moisture content requirements that must be satisfied to qualify for disposal. Based on potential disposal facility information, material moisture content for acceptance will need to be adjusted to less than 30% by weight. No sediment shall be removed from the Project that has seeping or otherwise free water exiting the truck at time of hauling.

H. All Phase I sediment materials are to be removed from the reservoir using the temporary access ramp and designated haul route within WTP. Reservoir bottom, temporary access ramp, haul routes and buried structures and utilities are to be protected from construction traffic damage. Observed damage should be documented and corrective actions undertaken immediately to prevent future damage. Contractor shall not deviate from approved haul routes. Contractor is responsible for all damages to existing WTP facilities. All Phase II sediment removal shall use the Permanent Access Ramp and established haul routes.

I. The Contractor shall not excavate trenches, pits, or cause other damage to reservoir slopes, or reservoir bottom below top of existing clay blanket liner or elevation 1034 feet, and to existing structures to facilitate dewatering, excavation and removal of sediment, unless approved by the Engineer and CCMWA.

J. Two haul vehicle cleaning (truck wash down) stations shall be established and operated by the Contractor. The approximate locations are shown in the Contract Documents. The Contractor shall submit to the Engineer for review and approval plans and specifications for the vehicle cleaning stations. Non-potable water shall be provided by CCMWA.

2.05 EXCAVATION SUPPORT

A. Where allowed, the Contractor shall furnish, place, and maintain such excavation support which may be required to provide safe working conditions and support sides of excavation or to protect structures, pipes, and utilities from possible. The Contractor shall be exclusively responsible for maintaining safe working conditions and structure integrity without overstressing or damaging existing structures, pipes, and utilities resulting from the Contractor temporarily placing, moving, or removing loads on or adjacent to existing structures, pipes, and utilities. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, the Engineer may order additional supports put in at the expense of the Contractor. The Contractor shall be responsible for the adequacy of all supports used and for all damage resulting from failure of support system or from placing, maintaining and removing the support system.

B. The selection of and design of any proposed excavation support systems is exclusively the responsibility of the Contractor. Contractor shall submit drawings and calculations to the Engineer on the proposed systems sealed by a Professional Engineer currently registered in the State of Georgia.

C. The excavation support system shall be installed by a specialized contactor with a minimum of five (5) years' experience installing the type of excavation support system proposed.

D. The Contractor shall exercise caution in the installation and removal of supports to ensure no excessive or unusual loadings or vibrations are transmitted to any new or existing structure. The Contractor shall promptly repair at their expense any and all damage that can be reasonably attributed to installation or removal of excavation support system.

E. Contractor shall monitor movement and vibration in the excavation support systems as well as movement and vibration at adjacent structures, utilities and roadways near excavation supports. Contractor shall submit a monitoring plan developed by the excavation support design engineer. All pre-construction condition assessment and documentation of adjacent structures on-site and off-site shall be performed by the Contractor. If any sign of distress such as cracking or movement occurs in any adjacent structure, utility or roadway during installation of supports, subsequent excavation, service period of supports, subsequent backfill and construction, or removal of supports, Engineer shall be notified immediately. The Contractor shall be exclusively responsible for repair of any damage to any roadway, structure, utility, pipes, etc. both on-site and off-site, as a result of their operations.

F. All excavation supports shall be removed upon completion of the work except as indicated herein. The Engineer may permit supports to be left in place at the request and expense of the Contractor. The Engineer may order certain supports left permanently in place in addition to that required by the Contract. The cost of the materials so ordered left in place, less a reasonable amount for the eliminated expense of the removal work omitted, will be paid as an extra by a Change Order in accordance with the General

Conditions and Division 01. Vibrations of new and existing structures shall be considered when the Contractor decides whether to remove excavation supports or leave them in place. Any excavation supports left in place shall be cut off at least two (2) feet below the finished ground surface or as directed by the Engineer.

2.06 PROTECTION OF SUBGRADE

A. To minimize the disturbance of bearing materials and provide a firm foundation, the Contractor shall comply with the following requirements:

1. Use of heavy rubber-tired construction equipment shall not be permitted on the final subgrade unless it can be demonstrated that drawdown of groundwater throughout the entire area of the structure is at least 3 feet below the bottom of the excavation (subgrade). Even then, the use of such equipment shall be prohibited should subgrade disturbance result from concentrated wheel loads.

2. Subgrade soils disturbed through the operations of the Contractor shall be excavated and replaced with compacted select fill or crushed stone at the Contractor's expense as indicated by the Engineer.

3. The Contractor shall provide positive protection against ponding of water, and penetration of frost into materials below the bearing level during work in winter months.

2.07 FIELD QUALITY CONTROL

A. The Contractor shall coordinate and schedule evaluation of all subgrades and bearing surfaces by the Engineer prior to performing subsequent construction activities.

B. Allowable bearing values of all areas beneath structures shall be tested. Tests shall be by penetrometer, rodding, rolling or other methods approved by the Engineer.

C. The Engineer, prior to the next phase of construction, shall approve all subgrades and bearing surfaces for structures.

2.08 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundations from freezing.

END OF SECTION

SECTION 31 05 16
AGGREGATE MATERIALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, equipment and materials required to complete all work associated with the installation of aggregate material beneath foundations, as backfill and as roadway subgrades and other related and incidental work as required to complete the work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 42 00 – References

B. Section 31 00 01 – Earthwork

C. Section 31 25 00 – Erosion and Sedimentation Control

D. Section 32 10 00 – Paving and Surfacing

E. Section 32 90 00 – Final Grading and Landscaping

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Georgia Department of Transportation (GDOT) Standard Specifications, Construction of Transportation Systems.

2. ASTM C 127 – Test for Specific Gravity and Absorption of Coarse Aggregate.

3. ASTM C 136 – Test for Sieve Analysis of Fine and Coarse Aggregates.

4. ASTM C 535 – Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Materials gradation and certification.

2. ASTM C127, ASTM C136, and ASTM C535 test results

PART 2 – PRODUCTS

2.01 CRUSHED STONE, SCREENED GRAVEL AND GRADED AGGREGATE BASE (GAB)

A. Crushed stone or screened gravel used in permanent construction shall meet the requirements of Aggregate Standard Size No. 57 or No. 67 as defined by GDOT Standard Specifications. Aggregates for temporary access/haul routes shall consist of GDOT #3 or #34 stone, unless otherwise approved by the Engineer.

B. GAB shall meet the requirements of GAB as defined by GDOT Standard Specifications.

2.02 SELECT SAND

A. Select sand shall meet the requirements of Section 801 Fine Aggregate of the GDOT Standard Specifications for materials and gradation.

PART 3 – EXECUTION

3.01 CRUSHED STONE, SCREENED GRAVEL, AND GRADED AGGREGATE BASE(GAB)

A. Contractor shall install crushed stone, screened gravel and GAB in accordance with the GDOT Standard Specifications and as shown on the Drawings and indicated in the Contract Documents.

1. Unless otherwise stated herein or shown on the Drawings, all mat foundations (bottom slabs) for the proposed structures outside the limits of the dam and reservoir shall have a blanket of crushed stone or GAB 6-inches thick minimum placed directly beneath the proposed mat. The blanket shall extend a minimum of 12 inches beyond the extremities of the mat.

2. For subgrade preparation at structures and structural fill outside the limits of the dam and reservoir, unless specifically called out, the foundation material shall be GAB where specified on Drawings, otherwise, crushed stone or screened gravel shall be used.

3. For ground under drains, pipe bedding, and drainage layers beneath structures outside the limits of the dam and reservoir, unless specifically called out, the coarse aggregate shall meet the requirements of aggregate standard Size No. 57 or No. 67, as defined by GDOT Standard Specification

3.02 SELECT SAND

A. Contractor shall install select sand in accordance with the GDOT Standard Specifications and as shown on the Drawings and indicated in the Contract Documents.

END OF SECTION

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SECTION 31 05 19
GEOTEXTILES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all Geotextiles, including all necessary and incidental items, as detailed or required for the Contractor to complete the installation in accordance with the Drawings and these Specifications.

B. For the location of each type of Geotextile see the Drawings.

1.02 REFERENCES

A. ASTM Standards

1. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles

2. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

3. ASTM D5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles

4. ASTM D6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

B. AASHTO Standards

1. AASHTO M 288-06 (2011) Geotextile Specification for Highway Applications

1.03 SUBMITTALS

A. Prior to shipping to the site, the Contractor shall submit to the Engineer two copies of a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for each type of Geotextile. The Supplier shall also submit three Geotextile samples of each product, 1 yard square each, seamed and unseamed as appropriate, with the mill certificate for each Geotextile type supplied. The mill certificate or affidavit shall attest that the Geotextile meets the chemical, physical and manufacturing requirements stated in the specifications. The samples shall be labeled with the manufacturer's lot number, machine direction, date of sampling, project number, specifications, manufacturer and product name.

B. The Engineer shall be furnished copies of the delivery tickets or other acceptable receipts as evidence for materials received that will be incorporated into construction.

PART 2 – MATERIALS

2.01 MATERIALS

A. Filter Geotextile shall be a minimum 6-ounce per square yard (nominal) nonwoven needle punched synthetic fabric consisting of polypropylene manufactured in a manner accepted by the Engineer and the Owner. The Geotextiles shall be inert and unaffected by long-term exposure to chemicals or liquids with a pH range from 3 to 10. The Geotextiles shall have a minimum threshold water head of 0.25-inches in the "as received" condition.

1. Filter Geotextile shall have a Survivability Class of Class 1 or 2 in accordance with AASHTO M288, unless otherwise specified herein.

B. Cushion Geotextile shall be a minimum 16-ounce per square yard nonwoven needle punched synthetic fabric consisting of continuous filament or staple polyester or polypropylene manufactured in a manner accepted by the Engineer and the Owner. The Geotextiles shall be inert and unaffected by long-term exposure to chemicals or liquids with a pH range from 3 to 10.

1. Cushion Geotextile shall have a Survivability Class of Class 1 in accordance with AASHTO M288.

C. Type I Separator Geotextile shall be a minimum 8-ounce per square yard (nominal) nonwoven needle punched synthetic fabric consisting of polypropylene manufactured in a manner accepted by the Engineer and the Owner. The Geotextiles shall be inert and unaffected by long term exposure to chemicals or liquids with a pH range from 3 to 10.

1. Type I Separator Geotextile shall have a Survivability Class of Class 1 or 2 in accordance with AASHTO M288, unless otherwise specified herein.

D. Type II Separator Geotextile shall be a woven slit film or monofilament synthetic fabric consisting of polyester or polypropylene in a manner approved by the Engineer. Geotextile shall be treated to resist degradation due to exposure to ultraviolet light.

1. Type II Separator Geotextile shall have a Survivability Class of Class 1 in accordance with AASHTO M288, unless otherwise specified herein.

E. All Geotextiles shall conform to the properties listed using the test methods listed in Table 1. The Contractor shall be responsible for timely submittals of all confirmation test data for Geotextiles.

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PART 3 – EXECUTION

3.01 SHIPPING, HANDLING AND STORAGE

A. During all periods of shipment and storage, all Geotextiles shall be protected from direct sunlight, temperature greater than 140°F water, mud, dirt, dust, and debris.

B. To the extent possible, the Geotextile shall be maintained wrapped in heavy-duty protective covering until use. Geotextile delivered to the project site without protective covering shall be rejected. After the protective covering has been removed, the Geotextile shall not be left uncovered for longer than fourteen (14) days, under any circumstances.

C. The Owner shall approve the shipping and delivery schedule prior to shipment. The Owner shall designate the on-site storage area for the Geotextiles. Unloading and storage of Geotextiles shall be the responsibility of the Contractor.

D. Geotextiles that are damaged during shipping or storage shall be rejected and replaced at Contractor expense.

3.02 QUALITY ASSURANCE CONFORMANCE TESTING

A. At the option of the Engineer representative samples of Geotextiles shall be obtained and tested by the Engineer to assure that the material properties conform to these Specifications. Conformance testing shall be conducted by the Engineer and paid for by the Owner.

B. Conformance testing shall be completed at a minimum frequency of one sample per 100,000 square feet of Geotextile delivered to the project site. Sampling and testing shall be as directed by the Engineer.

C. Conformance testing of the Geotextiles shall include but not be limited to the following properties:

1. Mass Per Unit Area (ASTM D5261)

2. Grab Tensile Strength (ASTM D4632)

3. Trapezoidal Tear (ASTM D4533)

4. Puncture Resistance (ASTM D6241)

D. The Engineer may add to, remove or revise the test methods used for determination of conformance properties to allow for use of improved methods.

E. All Geotextile conformance test data shall meet or exceed requirements outlined in Table 1 of these Specifications for the particular category of Geotextile prior to

installation. Any materials that do not conform to these requirements shall be retested or rejected at the direction of the Engineer.

F. Each roll of Geotextile will be visually inspected by the Engineer or his representative. The Engineer reserves the right to sample and test at any time and reject, if necessary, any material based on visual inspection or verification tests.

G. A Geotextile that is rejected shall be removed from the project site and replaced at the Contractor's expense. Sampling and conformance testing of the Geotextile supplied as replacement for rejected material shall be performed by the Engineer at Contractor's expense.

3.03 INSTALLATION

A. Geotextiles shall be placed to the lines and grades shown on the Drawings. At the time of installation, the Geotextile shall be rejected by the Engineer if it has defects, rips, holes, flaws, evidence of deterioration, or other damage.

B. It is the intent of these Specifications that Geotextiles used to protect natural drainage media be placed the same day as the drainage media to prevent soil, sediment or windblown soils to make contact with the drainage media.

C. The Geotextiles shall be placed smooth and free of excessive wrinkles. Geotextiles shall conform to and be in contact with the approved subgrade.

D. When the Geotextiles are placed on slopes, the upslope fabric portion shall be lapped such that it is the upper or exposed Geotextile.

E. Geotextiles shall be temporarily secured in a manner accepted by the Engineer prior to placement of overlying materials.

F. In the absence of specific requirements shown on the Drawings, the following shall be used for overlaps of adjacent rolls of Geotextile:

Geotextile Type / Application	Overlap of Adjacent Rolls(1) (Inches)	Transverse End Overlap (Inches)
Filter Geotextile	18 min	18 min
Cushion Geotextile	18 min	18 min
Separator - Roadway Applications	12 min	24 min
Separator - Slope Protection	18 min	24 min
Separator Geotextile	18 min	18 min

(1) Overlaps may be reduced if adjacent panels are sewn or heat bonded where approved by the Engineer.

G. Any Geotextile that is torn or punctured shall be repaired or replaced as directed by the Engineer by the Contractor at no additional cost to the Owner. The repair shall consist of a patch of the same type of Geotextile placed over the failed areas and shall overlap the existing Geotextile a minimum of 12-inches from any point of the rupture.

H. Any Geotextile that is subjected to excessive sediment buildup on its surface during construction shall be replaced by the Contractor prior to placement of overlying material.

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Table 1: Minimum Required Geotextile Properties*

Geotextile Property	Filter Geotextile	Cushion Geotextile	Type I Separator Geotextile	Type II Separator Geotextile
Geotextile Construction	Nonwoven Needle punched	Nonwoven Needle punched	Nonwoven Needle punched	Woven
Ultraviolet Resistance, (500 hrs.) ASTM D7238, Average % Strength Retention	70	70	70	70
Grab Tensile Strength (lbs.), ASTM D4632	205	340	205	315
Grab Tensile elongation (%) ASTM D4632	50	50	50	15
Trapezoid Tear Strength (lbs) ASTM D4533	80	155	80	120
Apparent Opening Size (AOS), (mm), ASTM D4751	0.18	N/A	0.18	0.425
Permittivity at 50 mm constant head (sec^{-1}), ASTM D4491	0.14	N/A	0.1.4	0.1
CBR Puncture Strength, ASTM D6241 (lb)	500	1100	500	900

* MINIMUM AVERAGE ROLL VALUE (MARV)

END OF SECTION

SECTION 31 10 00
CLEARING, GRUBBING, AND SITE PREPARATION

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Includes all labor, material, equipment and appliances required for the complete execution of any additions, modifications or alterations to existing building(s) and new construction work as shown on the Drawings and specified herein.

B. Principal items of work include:

1. Notifying all authorities owning utility lines running to or on the Project site (i.e., limits of construction), protecting and maintaining all utility lines to remain and capping those that are not required in accordance with instructions of the utility companies and all other authorities having jurisdiction

2. Clearing the site within the limits of disturbance, including removal of grass, brush, shrubs, trees, loose debris and other encumbrances, except for trees marked to remain

3. Boxing and protecting all trees, shrubs, lawns and the like within areas to be preserved and relocating trees and shrubs, as indicated on the Drawings, to designated areas

4. All injury to trees, shrubs and other plants caused by site preparation operations shall immediately be repaired. Work shall be done by qualified personnel in accordance with standard horticultural practice and as approved by the Engineer.

5. Removing topsoil to its full depth from designated areas and stockpiling on site where directed by the Engineer for future use

6. Disposing from the site all debris resulting from work under this Section

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 00 01 – Earthwork

B. Section 31 25 00 – Erosion and Sedimentation Control

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. All work shall be performed in compliance with the applicable requirements of the Environmental Protection Division of the Georgia Department of Natural Resources related to environmental protection.

1.04 STREET AND ROAD BLOCKAGE

A. Closing of streets and roads during progress of the Work shall be in compliance with the requirements of the Owner and other authorities having jurisdiction. Access shall be provided to all facilities remaining in operation.

1.05 PROTECTION OF PERSONS AND PROPERTY

A. All work shall be performed in such a manner to protect all personnel, workmen, pedestrians and adjacent property and structures from possible injury and damage.

B. All conduits, wires, cables and appurtenances located aboveground and belowground shall be protected from damage.

C. Provide warning and barrier fence where shown on the Drawings and as specified herein.

PART 2 – PRODUCTS

2.01 TREE PROTECTION (WARNING AND BARRIER) FENCE

A. The fence shall be made of a visible, lightweight, flexible, high-strength polyethylene material. The fence shall be Guardian Visual Barrier by Tenax or equal.

B. Physical Properties

Fence	
Color	International Orange
Height (feet)	4
Roll Weight (oz/SY)	3
Mesh Opening (inches)	1.75 x 1.75
Posts	
ASTM Designation	A702
Length (feet)	6 (T-Type)
Minimum Weight (pounds/foot)	1.25
Area of Anchor Plate (square inches)	14

PART 3 – EXECUTION

3.01 CLEARING OF SITE

A. Before removal of topsoil and start of excavation and grading operations, the areas within the limits of disturbance shall be cleared and grubbed.

B. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, fallen timber, brush, bushes, rubbish, sanitary landfill material, fencing, and other perishable and objectionable material within the areas to be excavated or other designated areas. Prior to the start of construction, the Contractor shall examine the entire Project site and prepare a plan which defines the areas to be cleared and grubbed, trees to be pruned, extent of tree pruning, and/or areas which are to be cleared but not grubbed. This plan shall be submitted to the Engineer for approval. Should it become necessary to remove a tree, bush, brush or other plants adjacent to the area to be excavated, the Contractor shall do so only after permission has been granted by the Engineer.

C. Excavation resulting from the removal of trees, roots and the like shall be filled with suitable material, as approved by the Engineer, and thoroughly compacted per the requirements contained in Section 31 00 01 – Earthwork.

D. Unless otherwise shown or specified, the Contractor shall clear and grub a strip at least 15-feet wide along all permanent fence lines installed under this Contract.

E. In temporary construction easement locations, only those trees and shrubs shall be removed which are in actual interference with excavation or grading work under this Contract, and removal shall be subject to approval by the Engineer. However, the Engineer reserves the right to order additional trees and shrubs removed at no additional cost to the Owner, if such trees and shrubs, in his opinion, are too close to the work to be maintained or have become damaged due to the Contractor's operations.

F. The Contractor shall minimize disturbance and trafficking of the embankment dam outside of areas to be excavated and/or designated as haul routes or stockpile/laydown areas.

3.02 STRIPPING AND STOCKPILING EXISTING TOPSOIL

A. Erosion and sedimentation control measures shall be installed per the federal, state or locally approved Erosion and Sedimentation Control Plan for the Project and Section 31 25 00 – Erosion and Sedimentation Control before any stripping and stockpiling of topsoil can occur.

B. Existing topsoil and sod on the site within areas designated on the Drawings shall be stripped to whatever depth it may occur and stored in locations directed by the Engineer.

C. The topsoil shall be free of stones, roots, brush, rubbish and other unsuitable materials before stockpiling the topsoil.

D. Care shall be taken not to contaminate the stockpiled topsoil with any unsuitable materials.

3.03 GRUBBING

A. Grubbing shall consist of the removal and disposal of all stumps, roots, logs, sticks and other perishable materials to a depth of at least 6 inches below ground surface.

B. Large stumps located in areas to be excavated may be removed during grading operations, subject to the approval of the Engineer.

3.04 DISPOSAL OF MATERIAL

A. All debris resulting from the clearing and grubbing work shall be disposed of by the Contractor as part of the Work of this Contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed by the Engineer for reuse in this Project or removal by others.

B. Burning of any debris resulting from the clearing and grubbing work is not acceptable at the Project site.

3.05 TREE PROTECTION (WARNING AND BARRIER) FENCE

A. Drive posts 18 inches into ground every 8 feet. Wrap fence material around first terminal post, allowing overlap of one material opening. Use metal tie wire or plastic tie wrap to fasten material to itself at top, middle and bottom. At final post, cut with utility knife or scissors at a point halfway across an opening. Wrap around and tie at final post in the same way as the first post.

B. Also use metal tie wire or plastic tie wrap at intermediate posts and splices. Thread ties around a vertical member of the fence material and the post and tightly bind against the post. For the most secure fastening, tie at top, middle and bottom. Overlap splices a minimum of four fence openings and tie as previously specified herein, fastening both edges of the fence material splice overlap.

END OF SECTION

SECTION 31 23 19
DEWATERING AND WATER CONTROL

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Furnish all labor, materials, and equipment and perform all work necessary to lower and control all free water, ponded water, collected water, and seepage including water associated with the removal of saturated sediments and sediment drying, truck wash facilities, haul road maintenance, rainfall and runoff into and outside the reservoir, trapped water within pipe bedding, and natural groundwater for the duration of the project to permit all excavations and construction to be performed in dry conditions. All construction activities are intended to be performed in a dry condition. The contractor shall employ all reasonable means and methods for removing water. Accumulated and pumped water shall be disposed of in accordance with Contract Documents and Section 31 25 00 – Erosion and Sedimentation Control.

B. The work includes but is not limited to the following:

1. Testing, operation, maintenance, supervision, dewatering, and final dismantling and removal from the site of the dewatering and water control systems.

2. The cost of any replacement or rehabilitation of the subgrade or structures damaged due to dewatering and water control systems operation, failure, or Contractor negligence. If surface and subsurface water is not adequately controlled, more extensive undercutting and construction delays should be anticipated. It will be the Contractor's responsibility to ensure adequate dewatering and water control is maintained. Any costs for additional excavation, undercutting, or stabilization that is required due to inadequate surface or groundwater controls shall be borne by the Contractor.

3. Compliance with all regulations relating to this work.

4. The diversion, collection, and removal of all ice, snow, surface runoff, trapped water from the work areas, and removal of groundwater from new excavations to permit construction in the dry.

5. The contractor will not be allowed to route any accumulated, collected, or pumped water through the Water Treatment Plants.

C. The Contractor shall make themself thoroughly familiar with the surficial and subsurface conditions to adequately accomplish the appropriate construction requirements without causing disturbance or deterioration of the adjacent or underlying soils.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Divisions 01, 02, 31, and 32 of these Specifications, including but not limited to:

1. Section 02 41 16 – Demolition and Removal of Existing Structures and Equipment

2. Section 31 00 01 – Earthwork

3. Section 31 00 02 – Excavation

1.03 REFERENCE SPECIFICATIONS CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents to the extent that the provisions therein are not in conflict with the requirements of this Section.

1. Bureau of Reclamation – Groundwater Manual Sediment Test by Imhoff Cone

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Name and qualifications of dewatering and water control subcontractor, if applicable.

2. Pre-construction condition inspection and monitoring plan with documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems, near areas where subsurface dewatering is required to facilitate construction in the dry, and along haul routes within WTP boundaries.

3. Procedures for dewatering and control of water proposed by the Contractor shall be submitted for review and approval of Engineer prior to any earthwork operations. Submittal shall indicate the following, if applicable:

a. Plans showing the methods and location of dewatering and water control systems and discharge including a sufficient number of detailed sections to clearly illustrate the scope of work.

b. Relationship of the dewatering and water control systems, observation wells, and discharge lines to existing buildings, other structures, utilities, streets, and new construction.

c. Utility locations.

d. Drawings shall bear the seal and signature of a qualified Registered Professional Engineer licensed in the state of Georgia.

e. List of materials, equipment, and backup equipment to be used.

1.05 QUALITY ASSURANCE

A. The Contractor shall be solely responsible for the arrangement, location, and depths of the dewatering and water control system necessary to accomplish the work described herein.

B. Dewatering and water control shall prevent the loss of fines, seepage, boils, quick conditions or softening of the foundation strata while maintaining stability of the sides and bottom of all excavations including reservoir sides and bottom and providing dry conditions for construction operations. The integrity and composition of the existing clay liner blanket within the reservoir must be maintained throughout all dewatering and water control activities.

PART 2 – PRODUCTS

2.01 MATERIALS

A. The Contractor shall provide all pumps, sumps, well points, temporary drains, and appurtenant equipment necessary to control groundwater and surface water.

B. Materials, especially filter screens for pumps and sediment bags, shall be carefully chosen to be compatible with the environment to prevent erosion, deterioration, and clogging.

PART 3 – EXECUTION

3.01 EXAMINATION OF THE SITE

A. Become familiar with the surface and subsurface site conditions.

B. Obtain the data required to analyze the water and soil environment at the site in order to assure that the materials used for the dewatering and water control systems will not erode, deteriorate, clog or otherwise hinder the systems' performance during the period of the construction requiring such activities.

C. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of the reservoir and embankment, inlet and outlet structures, Splitter Box and adjoining structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

3.02 DESIGN

A. The Contractor shall intercept and collect runoff at the top and bottom of excavated slopes as required to prevent erosion and to keep excavations at their base free of water. All temporary fill surfaces shall be sloped to provide drainage to erosion control structures.

B. The dewatering and water control systems, shall be capable of relieving all hydrostatic pressure against the height of the excavation walls and of lowering the hydrostatic level below the bottom of the base slab a minimum of three (3) feet in the work areas both prior to excavation, and during excavation and construction.

C. The dewatering and water control systems shall be segmented so that if the operation of any one segment is disrupted, the remaining segment plus activated redundant components are capable of maintaining the groundwater and free water at the stated levels.

D. Provide, operate and maintain all ditches, berms, site grading, sumps and pumping facilities to divert, collect and remove all surface water from work areas. All collected water shall be discharged into the outfall pipe.

E. Provide pipe and pumps of sufficient size and quantity to be able to flood the excavation within 12 hours in an emergency situation. Restoration of the working area shall be carried out by the Contractor at no additional cost to the Owner.

F. Carry the dewatering system discharge through pipes out of the area of the excavation into the designated outfall as shown on the Drawings or designated in the Contract Documents. Provide meters to measure the discharge flow.

G. Place a portion of the header and discharge system underground to provide vehicle crossings or access to existing structure as required.

H. Provide additional and adequate standby dewatering and water control equipment to prevent cessation of work activities as directed by the Engineer or CCMWA due to inadequate dewatering and water control performance.

3.03 INSPECTION

A. Dewatering and water control systems shall be inspected daily by the Contractor and Engineer to ensure operation, effectiveness of systems and compliance with project requirements.

B. Provide corrective measures as deemed necessary based on Contractor inspection and as directed by Engineer.

3.04 DEWATERING AND CONTROL OF WATER

A. Following initial removal of reservoir water by CCMWA, the Contractor shall be responsible for removal of all remaining water, dewatering and water control measures within the limits of reservoir interior.

B. The Contractor shall provide all pumps, sumps, well points, temporary drains, and appurtenant equipment necessary to complete initial removal of remaining reservoir water, and control groundwater and surface water. No water shall be routed through the WTP facility following the initial Phase I and Phase II drawdowns performed by CCMWA.

C. In general excavations outside the reservoir interior, the contractor shall draw down and control all surface water, free water and groundwater to at least 3-feet below the deepest point of any excavation in advance of performing the excavation and continuously dewater to maintain a dry and undisturbed condition until all associated construction is complete. Control of trapped and flowing water from within existing bedding materials should be anticipated. Dewatering and control of water should be performed continuously, 24/7 and limit the collection of and loss of soil sediments through the processes implemented.

D. Within the reservoir interior, the contractor shall control all surface water and free water associated with reservoir draining, rainfall and sediment drying. No excavations into and below the clay liner blanket will be allowed, unless authorized by the Engineer. The integrity and composition of the existing clay blanket liner must be maintained during sediment excavation, processing and removal. The contractor should anticipate the use of earth berms, shallow ditches within the sediment layer and shallow draft suction pumps. The contractor should also anticipate considerable water control during significant rain events over the reservoir.

E. The Contractor shall intercept and collect runoff at the top and bottom of excavated slopes as required to prevent erosion and to keep excavations at their base free of water. All temporary fill surfaces shall be sloped to provide drainage to erosion control structures.

3.05 REMOVAL OF DEWATERING AND WATER CONTROL SYSTEMS

A. Obtain written approval from the Owner and Engineer to discontinue dewatering and water control operations.

B. Provide an adequate weight of fill to prevent buoyancy at structures and pipes where groundwater and/or persistent water flow is present.

C. Remove all dewatering and water control systems including, buried and surface piping, cables, pump foundations, structural supports and all other support facilities.

D. Backfill as specified in Section 31 00 01 – Earthwork, all trenches and excavations below final grades or in fill areas.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall be responsible for implementing best management practices (BMPs) to prevent and minimize soil erosion and resultant sedimentation in all cleared and grubbed areas during and after construction. This item covers all work necessary for the installation of structures and measures to control soil erosion resulting from construction operations, prevent the flow of sediment from the construction site, and contain construction materials (including excavation and backfill) within the protected working area to prevent damage to any stream or wetlands. The Contractor shall furnish all material, labor, and equipment necessary for the proper installation, maintenance, inspection, monitoring, reporting, and removal (where applicable) of erosion prevention and sediment control measures and, if applicable, to cause compliance with all local permits and the NPDES Permit as defined herein under this Section.

B. Any land disturbance as the result of modifications to a site's drainage features or topography requires protection from erosion and sedimentation.

C. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.

D. It is the intent of this Section that the Contractor conduct the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized.

E. All work under this Contract shall be done in conformance with and subject to the limitations of the Manual for Erosion and Sediment Control in Georgia (the "Green Book"), 2016 Edition or latest update, as adopted by the Georgia Soil and Water Conservation Commission (GSWCC).

F. Due to the nature of the work required by this Contract, it is anticipated that the location and nature of the erosion and sediment control devices will be adjusted on several occasions to reflect the current phase of construction. The construction schedule adopted by the Contractor will impact the placement and need for specific devices required for the control of erosion. The Contractor shall develop and implement such additional techniques as may be required to minimize erosion and off-site sedimentation. The location and extent of erosion and sedimentation control devices shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from constructed areas. All deviations from the erosion and sedimentation control provisions shown on the Drawings shall have the prior acceptance of the Engineer and shall be completed at no additional cost to the Owner.

G. Erosion and sedimentation controls applicable to this Project shall be as shown on the Drawings, as specified herein, as indicated by the Engineer, and as detailed in the

GSWCC “Green Book”.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittal Procedures

B. Section 31 00 01 – Earthwork

C. Section 31 05 16 – Aggregate Materials

D. Section 31 05 19 – Geotextiles

E. Section 32 90 00 – Final Grading and Landscaping

F. Section 32 92 23 – Sodding

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section:

1. General NPDES Permit NO. GAR100001 – Authorization to Discharge Under the National Pollutant Discharge Elimination System – Storm Water Discharges Associated With Construction Activity For Stand Alone Construction Projects (the NPDES Permit)

2. GSWCC “Green Book”, 2016 Edition or latest update

3. Georgia Department of Transportation Standard Specifications, Construction of Transportation Systems (GDOT Standard Specifications)

4. National Stone Association, Aggregate Classification (the NSA Classification)

5. Cobb County Soil Erosion and Sedimentation Control Ordinance

6. Erosion, Sedimentation, and Pollution Control Plan (the Plan) as required by the NPDES Permit

1.04 QUALITY ASSURANCE

A. Contractor’s operations shall be restricted to the areas of work shown on the Drawings and the area which must be entered for construction of temporary or permanent facilities.

B. Engineer and Owner reserve the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, and borrow and fill operations and to direct the Contractor to install immediate permanent or temporary erosion, sediment, and pollution control measures to prevent contamination of any stream or wetlands, including the construction of temporary berms, dikes, dams, sediment basins, sediment traps, and slope drains and the use of temporary mulches, mats, or other devices or

methods to control erosion.

1.05 DEFINITIONS

A. Engineer: For the purpose of this Section, the term Engineer is synonymous with consulting engineer, licensed professional, designer, and consultant used in permits, laws, rules, regulations, ordinances, and other soil erosion and sediment control references. For the purposes of this item, the Engineer may at any time during the Project provide direction. This direction shall be considered equivalent to direction from the Owner.

B. Contractor: For the purposes of this Section, the term Contractor is synonymous with General Contractor, Discharger, Operator, Primary Permittee, and Permittee (permit holder) as used in permits, laws, rules, regulations, ordinances, and other soil erosion and sediment control references.

C. Qualified Personnel: For the purposes of this Section, the terms Qualified Personnel or Qualified Person mean a person who has successfully completed an erosion and sediment controls short course eligible for continuing education units or an equivalent course approved by the Environmental Protection Division (EPD) of the Georgia Department of Natural Resources (DNR) and the GSWCC.

D. Other Definitions: Definitions as listed in the NPDES Permit, Part I.B. shall apply in this Section.

1.06 REGULATORY COMPLIANCE

A. Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States, the State of Georgia, and Cobb County as necessary. The Contractor is the Co-Primary Permittee and Operator under the provisions of the NPDES Permit. As such, the Contractor shall be required to sign certain certifications as described in the NPDES Permit and submit a Notice of Intent (NOI) and Notice of Termination (NOT) as indicated herein in Article 1.07 and Article 3.04, respectively. Contractor shall comply with requirements specified in the Contract Documents, on the Plan, and by the Engineer. Contractor shall also comply with all other laws, rules, regulations, ordinances, and requirements concerning soil erosion and sediment control established in the United States, the State of Georgia, and Cobb County as applicable. The following documents and the documents referenced therein define the regulatory requirements for this Section:

   1. The NPDES Permit: The NPDES Permit governs land disturbance or construction activities of 1 acre or more. On applicable sites, Contractor shall be responsible for complying with terms and conditions of this permit.

   2. GSWCC “Green Book”: Contractor shall follow Practices and Standards of the latest edition of the GSWCC “Green Book”.

B. During the period beginning on the effective date of the Notice to Proceed and lasting until the Project is accepted by the Owner, the Contractor shall control, limit, and monitor all discharged stormwater associated with construction activity including clearing, grading, and excavation activities resulting in the disturbance of land and related support activities as specified and as follows:

1. Manage onsite activities such that no adverse impacts to water quality occur from site activities or allowed discharges. The following activities, and others on a site-specific basis, require oversight throughout the construction and development process to assure that all water quality standards are protected.

    a. Equipment Operation and Maintenance: Equipment utilized during construction must be operated and maintained in such a manner to prevent the potential or actual pollution of the surface or ground waters of the State. Chemicals, fuels, lubricants, bitumen, coolants, hydraulic fluids, or any other petroleum products or harmful waste shall not be discharged onto the ground, into or alongside any surface waters, or into natural or manmade channels. Spent fluids shall be disposed of in a manner to not enter the groundwater or surface waters of the State and in accordance with applicable state and federal disposal regulations. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner to not allow their entry into the ground water or surface waters of the State.

    b. Material Handling: Herbicide, pesticide, and fertilizer usage during the construction activity shall be consistent with the Federal Insecticide, Fungicide, and Rodenticide Act and in accordance with label restrictions.

    c. Building Material Waste Handling: All wastes composed of building materials shall be disposed of in accordance with applicable state and federal rules governing the disposal of solid waste. In particular, the following guidelines shall be followed:

        i. No paint or liquid wastes shall be disposed of in streams or storm drains.

        ii. Dedicated area for demolition, construction, and other wastes must be located a minimum of 50 feet from storm drains and streams unless no reasonable alternatives are available.

        iii. Earthen-material stockpiles must be located a minimum of 50 feet from storm drains and streams unless no reasonable alternatives are available.

        iv. Onsite concrete materials, including excess concrete, must be controlled to avoid contact with surface waters, wetlands, and buffers.

    d. Litter and Sanitary Waste: The Permittee shall control the management and disposal of litter and sanitary waste from the site.

C. Violations and Fines

1. Contractor shall be responsible for reimbursing the Owner for any fines incurred as a result of violations to the Georgia Erosion and Sedimentation Act, the NPDES Permit, and any applicable delegated local program's sediment control regulations until construction activities are complete and the project is accepted by the Owner.

These include fines levied by the Georgia EPD Land Protection Branch, Georgia EPD Watershed Protection Branch, and delegated local programs.

2. If violations result in the issuance of a Notice of Violation, the Contractor shall comply with the requirements of the Notice within the specified time period for compliance. Failure to comply could result in the assessment of a penalty for each day of the continuing violation, beginning on the date of the violation.

3. Violations may result in civil and/or criminal penalties including fines and imprisonment.

1.07 SUBMITTALS

A. Prior to the start of the work, the Contractor shall prepare and submit a plan for implementing the temporary and permanent erosion and sedimentation control measures as shown on the Plan approved by the appropriate regulatory authority. Construction work shall not commence until the schedule of work and the methods of operations have been reviewed and approved.

B. The Contractor shall submit a Notice of Intent (NOI) for the NPDES Permit to Georgia EPD prior to breaking ground. NOI shall be electronically completed and submitted through the Georgia EPD Online System (GEOS) in accordance with the requirements of the NPDES Permit. Submittal shall be coordinated with Owner and Engineer. Contractor shall be responsible for paying all fees associated with the NPDES Permit.

C. Contractor shall submit a proposed schedule for installation, maintenance, and removal of all temporary and permanent erosion and sediment control measures to the Engineer. The schedule shall reflect the requirements of Article 1.09 and shall state the anticipated starting and completion dates for all land development activities including:

1. Installation of temporary and permanent sediment control structures

2. Stormwater management facilities

3. Timber salvage operations

4. Clearing operations

5. Grubbing operations

6. Rough and finished grading

7. Building construction

8. Landscaping, including all seeding and sodding

9. Removal of temporary sediment control structures

D. Contractor shall submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Product Data

2. Hydroseed mix and application rates for seed, lime, fertilizer, and wood cellulose fiber mulch

3. Certification of all materials

4. Composition and germination certification of test results for grass seed

5. Plans and specifications for two vehicle cleaning (truck wash down) stations.

E. In accordance with the procedures and requirements set forth in the Standard General Conditions of The Construction Contract and Division 1 – General Requirements including, but not limited to, Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following:

1. Name and location of all material suppliers

2. Certificate of compliance with the standards specified herein for each source of each material

3. List of offsite borrow sources and disposal sites for waste and unsuitable materials and evidence of all required federal, state, and local permits for use of those sites

1.08 GUARANTEE

A. All restoration and revegetation work shall be subject to the 1-year guarantee period of the Contract as specified in the General Conditions.

1.09 SEQUENCE OF CONSTRUCTION OF TEMPORARY SEDIMENT CONTROL MEASURES

A. Install all erosion and sediment control structures specified herein and shown on the Drawings, or as directed by the Engineer, as the first item of work within a given drainage area. Construction and installation of all sediment control structures shall begin downgrade of the area to be disturbed and shall proceed upgrade. Contractor shall maintain all soil erosion and sediment control structures and practices at all times throughout construction and until permanent grass cover is established.

B. Time: Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States, the State of Georgia, and Cobb County.

1.10 BUFFER ZONES

A. Construction within a buffer zone of a Water of the United States must meet the following requirements.

B. Definition: The buffer zone is officially defined as the distance (in feet) from the edge of the normal high water line (or for wetlands, the distance from the boundary of the wetland). The buffer zone for small streams (as determined by the Engineer) shall start at the top of the bank, and the buffer zone for larger streams (as determined by the Engineer) and rivers shall start at the edge of the vegetation. Buffer zones are specified in the following table:

Type of Water of the United States	Buffer
Streams and unnamed tributaries	
No-Impervious Surface Setback	75 feet
Undisturbed Stream Buffer	50 feet
Minimum State Stream Buffer	25 feet
Other Waters of the United States	25 feet

C. Construction Activity: Construction activity within the buffer zone must be approved by the Engineer. Any encroachments must immediately be mulched and/or seeded in accordance with the requirements of Article 2.11 (the General Criteria of Article 2.11 are superseded by the requirements of Article 1.10). All construction within a buffer zone must be complete as soon as possible and within 24 hours of initial land disturbance within the buffer when possible.

PART 2 – PRODUCTS

2.01 SPECIFIC REQUIREMENTS

A. The requirements specified herein and shown on the Drawings are minimum requirements for the preventing or minimizing soil erosion and sediment transport. Contractor shall install and maintain soil erosion and sediment control measures in accordance with the following criteria. Requirements set forth in the latest edition of the GSWCC “Green Book” shall govern in case of conflicting information, unless clearly identified as a deviation from the GSWCC “Green Book”.

2.02 TEMPORARY INTERCEPTOR, DIVERSION, AND PERIMETER DIKES

A. Install interceptor, diversion, and perimeter dikes to intercept and prevent storm water runoff from entering disturbed areas from any other upgrade area regardless of whether area is on-site or off-site. Dikes must divert runoff to a drainage ditch, sediment basin, or temporary or permanent channel. Dikes shall remain in place until the disturbed area is permanently stabilized. Construct dikes of earth fill free from all perishable matter and refuse, such as scrap forms, wire, brush, rocks larger than 6 inches, or any foreign materials. Ashes, large stones, muck, or other soft materials shall not be used. Compact all dikes using construction equipment. Dikes shall be stabilized immediately after construction with temporary seeding to prevent sediment transport to downstream areas.

2.03 TEMPORARY INTERCEPTOR, DIVERSION, AND PERIMETER DITCHES

A. Install temporary ditches where shown on the Drawings or as directed by the Engineer. In general, temporary ditches shall be installed parallel and contiguous to and upgrade of

temporary dikes. Construct ditches to the lines and cross section shown on the drawings, provided that ditches have a minimum depth of 1 foot and side slopes have a slope of 2H:1V or flatter. Ditches shall be free of bank projections, trees, brush, stumps, or other objectionable materials or irregularities that will impede normal flows. Downstream outlets of temporary ditches shall be constructed and stabilized prior to construction of the ditch. The outlet must discharge in such a manner as to not cause an erosion problem.

2.04 TEMPORARY SEDIMENT BARRIERS (SILT FENCE)

A. Install silt fence where shown on the Drawings or as directed by the Engineer.

B. Material Specifications: Filter fabric, woven wire support fence or polypropylene support mesh, posts, and fasteners must meet the requirements set forth in Section 171 – Silt Fence, Section 881 – Fabrics, and Section 894 – Fencing of the GDOT Standard Specifications. Contractor shall submit to Engineer copies of delivery invoices, certifications, or other documentation that the filter fabric, woven wire support fence or polypropylene support mesh, posts, and fasteners comply with these specifications if requested by the Engineer.

C. Installation: In general, silt fencing shall be installed on the downgrade side of all areas to be disturbed as well as the perimeter of the Project site (Engineer may authorize an exception for a perimeter which is upgrade from all land disturbing activity). Installation of silt fence shall comply with the specifications in the latest edition of the GSWCC "Green Book". Posts must be placed at least 18 inches in the ground and cannot be more than 6 feet apart from one another. Fence fabric must be inserted below ground and fence fabric must be fastened to posts according to the specifications in the Manual. Contractor shall install either Type A, Type B, Type C, or Type C-System silt fence, as shown on the Drawings or when directed by the Engineer.

D. Maintenance: In accordance with Article 3.01, all silt fencing shall be inspected and maintenance performed, if needed, within 24 hours of inspection and once every 7 calendar days and within 24 hours of a rainfall event that had precipitation of 1/2 inch or greater. All silt fencing materials, including fabric, post, and fasteners must be replaced 6 months after installation. At the earlier of (1) every 14 calendar days, or (2) when sediment reaches a depth of 1/3 the installed fence height, all soil, silt, sediment, and other material captured by the silt fence shall be removed and returned upgrade on the construction site to a location which will minimize the chance for further sediment transport. Temporary or permanent ground cover shall be established as necessary to reduce erosion. The silt fence shall be maintained such that it minimizes sediment transport as designed.

2.05 TEMPORARY SEDIMENT BARRIERS (HAY BALES)

A. Install bales of hay where shown on the Drawings or as directed by the Engineer.

B. Material Specifications: Hay bales shall be wire or nylon bound and of rectangular shape.

C. Installation: Place bales in a row with ends tightly abutting the adjacent bales. Corner abutment is not acceptable. Embed bales in the soil a minimum of 4 inches below grade. Build up backfilled soil a minimum of 4 inches above grade on the uphill side of the barrier and conform to grade on the downhill side of the barrier. Anchor each bale in place with 1-inch by 2-inch wood stakes or No. 3 reinforcing bars. The first stakes shall be driven

toward the previously laid bale to force the bales together. Stakes shall be 24 inches long and shall reach a minimum of 6 inches into the ground.

D. Maintenance: In accordance with Article 3.01, all hay bales shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. Hay bales must be replaced 1 month after installation. At the earlier of (1) every 14 calendar days or (2) when sediment and other material captured by the hay bales reaches 1/3 the height of the original bales such sediment shall be removed and returned upgrade on the construction site. The hay bales shall be maintained such that they minimize sediment transport as designed.

2.06 STONE FILTERS

A. Install stone filter where shown on the Drawings or as directed by the Engineer.

B. Material Specifications: Filter fabric must meet the requirements set forth in Section 171 – Silt Fence, of the GDOT Standard Specifications. Stone shall be No. 57 stone as defined by GDOT Standard Specifications. Contractor shall submit to Engineer copies of delivery invoices, certifications, or other documentation that the filter fabric, stone, and hardware cloth complies with these specifications if requested by the Engineer.

C. Installation: In general, stone filters shall be installed at the low point of all silt fence as the perimeter of the Project site (Engineer may authorize an exception for a perimeter which is upgrade from all land disturbing activity). All posts used to install silt fence shall comply with the specifications in the latest edition of the GSWCC “Green Book”. Posts must be placed at least 18 inches in the ground and cannot be more than 3 feet apart from one another. Fence fabric must be inserted below ground, and fence fabric and cloth hardware must be fastened to posts according to the specifications in the Manual. Contractor shall install fence as shown on the Drawings or when directed by the Engineer. Minimum length of stone filter shall be 10 feet.

D. Maintenance: In accordance with Article 3.01, all stone filters shall be inspected and maintenance performed, if needed, within 24 hours of inspection and once every 7 calendar days and within 24 hours of a rainfall event that had precipitation of 1/2 inch or greater. All materials, including filter fabric, stone and cloth hardware, post, and fasteners must be replaced 6 months after installation. At the earlier of (1) every 14 calendar days, or (2) when sediment reaches a depth of 1/3 the installed height, all soil, silt, sediment, and other materials captured by the stone filter shall be removed and returned upgrade on the construction site. The stone filter shall be maintained such that it minimizes sediment transport as designed. Hardware cloth between filter fabric and No. 57 stone shall be 1/2-inch mesh. Stone shall be No. 57 stone as defined by GDOT Standard Specifications.

2.07 CONSTRUCTION EXITS

A. Locate construction exits as shown on the Drawings or as directed by the Engineer.

B. Material Specifications: A geotextile underliner, conforming to Section 881.2.05 – Plastic Filter Fabric, GDOT Standard Specifications, shall be used in all instances to stabilize and support the pad aggregate. Aggregate size shall conform to the National Stone

Association's (NSA) R-2 classification 1.5-inch to 3.5-inch stone.

C. Installation: Construction exits shall be located at all points where traffic will be leaving the construction site to a public or private right of way, street, alley, or parking area. All construction exits must be fully installed prior to the commencement of timber salvage, clearing, grubbing, grading, or construction operations.

D. Maintenance: In accordance with Article 3.01, all construction exits shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. At the earlier of (1) 30 calendar days since construction exit was installed or last maintained, or (2) geotextile underliner is visible or if construction exit does not conform to specifications established in this Section, construction exit pad shall be top dressed with NSA's R-2 (1.5-inch to 3.5-inch stone) such that underliner is no longer visible and exit pad conforms to specifications.

2.08 CHECK DAMS

A. Install check dams as shown on the Drawings or as directed by the Engineer.

B. Installation: Install check dams in all ditches, channels, or swales draining disturbed areas of 1 acre or greater and which are not installed with permanent, non-erodible lining or a vegetative cover as specified in Article 2.11. The specifications for the design criteria, materials, installation, and maintenance of check dams are dependent on the upslope drainage area and are described below. A check dam shall not drain a disturbed area greater than 10 acres.

1. Check Dam for Ditches Draining up to 2 Acres: Hay bales may be used if installation conforms to the specifications established in Article 2.05.

2. Check Dam for Ditches Draining Up to 5 Acres: Install stone check dams in ditches draining upgrade areas greater than 2 acres but less than 5 acres. Construct check dam with graded size 5- to 10-inch stone. Hand placement may be required to insure complete coverage of the entire width of ditch.

3. Check Dam for Ditches Draining Up to 5 to 10 Acres: Check dams for use with drainage areas between 5 and 10 acres must serve as a sediment filtering device in addition to reducing the velocity of storm water runoff. Construct check dam with graded size 5- to 10-inch stone. Check dam shall not substantially impound water. Hand placement may be required to ensure complete width and depth of ditch.

C. Maintenance: In accordance with Article 3.01, all check dams shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. Dress dams with appropriate sized stone or additional hay bales as necessary to maintain check dams in accordance with these specifications. At the earlier of (1) every 14 calendar days, or (2) when sediment reaches a depth of 1/3 the original check dam height, all soil, silt, sediment, and other material captured by the dam shall be removed and returned upgrade on the construction site.

2.09 INLET SEDIMENT TRAP

A. Install inlet sediment traps where shown on the Drawings, as directed by the Engineer, and all around storm drain drop inlets that receive runoff from disturbed areas.

B. Material Specifications: Filter fabric used on constructing inlet sediment traps shall conform to the specifications established in Article 2.06. For gravel drop inlet filters, stone shall conform to NSA's R-3 specification (3- to 6-inch stone). Baffle box inlet filters shall be constructed of 2-inch x 4-inch posts and 2-inch x 4-inch boards.

C. Installation: Install in accordance with Chapter 6 of the latest edition of the GSWCC "Green Book". Excavation may only be used in combination with a filtering device such as stone or silt fence. All sediment traps shall provide a minimum of 1.5 feet of sediment storage. Sediment traps must be self-draining.

D. Maintenance: In accordance with Article 3.01, all inlet sediment traps shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. Clean and repair traps such that traps meet the specifications of this Section and minimize sediment transport. Remove sediment as necessary to provide adequate storage volume for subsequent rains.

2.10 TEMPORARY SEDIMENT BASINS AND INLETS

A. Install temporary sediment basins and inlets where shown on the Drawings or as directed by the Engineer.

B. Material Specifications: Concrete used in constructing sediment basins shall be ready mixed, conforming to ASTM C94, Alternate 2. Compressive filed strength shall be not less than 2,500 psi at 28 days. Maximum size of aggregate shall be 1.5 inches. Slump shall be between 2 and 4 inches. Field strength shall be assumed as equal to 85 percent of the strength of laboratory-cured cylinders. Forms used in constructing sediment basin shall have exposed surfaces of plywood; others shall be steel, matched boards, plywood, or other acceptable material. Form all vertical surfaces. Provide fillets on reentrant angles. Trench walls, large rock, or earth are not acceptable form material. Reinforcing steel shall conform to ASTM A615, Grade 40, deformed bars. At the option of the Contractor, approved precast units may be substituted for cast-in-place units. Precast units shall conform to ASTM C478. Submit details of proposed units to the Engineer for review. Concrete risers for extension shall be a maximum of 6 inches high and of the same quality as the sections. Risers shall be reviewed by Engineer before installation. Mortar shall be standard premised mortar conforming to ASTM C387, Type S, or proportion 1 part Portland cement to 2 parts clean, well-graded sand which will pass a 1/8-inch screen. Admixtures may be sued not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the concrete. Cast iron frames and gratings for catch basins and storm drain inlets shall be designed for AASHTO H-20 truck loading and shall be bike-proof reticuline grates. Bearing surfaces shall be clean and shall provide uniform contact. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts and all defects, and shall conform to ASTM A48, Class 30.

C. Construction: Excavation of basin and backfill of any adjoining pipe trenches shall be as

specified in Section 31 00 01 – Earthwork. Construct forms to the dimensions and elevations required. Forms shall be tight and well braced. Chamfer corners of forms. Prior to placing the concrete, remove all water and debris from the forms. Moisten forms just prior to placing the concrete. Handle concrete from the transporting vehicle to the forms in a continuous manner as rapidly as practical without segregation or loss of ingredients. Immediately after placing, compact concrete with a mechanical vibrator. Limit the duration of vibration to the time necessary to produce satisfactory consolidation without causing segregation. Screed the top surface of exposed slabs and walls. When the initial water has been absorbed, float the surfaces with a wood float and lightly trowel with a steel trowel to a smooth finish free from marks or irregularities. Finish exposed edges with a steel edging tool. Remove forms and patch any defects in the concrete with mortar mixed in the same proportions as the original concrete mix. Cure concrete by preventing the loss of moisture for a period of 7 days. Accomplish with a membrane-forming curing compound. Apply the curing compound immediately after removal of forms or finishing of the slabs. Protect concrete from damage during the 7-day curing period. If precast unit is used and material in bottom of trench is unsuitable for supporting unit, excavate and backfill to required grade with 3-inch minus, clean pit-run material. Set units to grade at locations shown. Set frames and grates at elevations indicated on Drawings. Frames may be cast in or shall be set in mortar.

D. Maintenance: In accordance with Article 3.01, temporary sediment basins and inlets shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. Clean and repair basins and inlets such that they meet the specifications of Article 2.09 and minimize sediment transport. Remove sediment as necessary to provide adequate storage volume for subsequent rains.

2.11 TEMPORARY SOIL EROSION STABILIZATION (VEGETATIVE)

A. This section covers work necessary for temporary stabilization of soil to prevent erosion following clearing, grubbing, grading, or other construction, except wetlands. The Engineer may modify the use, location, and quantity of the areas requiring stabilization as considered being in the best interest of the Owner. Temporary stabilization within a buffer zone of Water of the United States shall meet the requirements of Article 1.08.

B. General Criteria: The stabilization measures specified herein shall be initiated on all disturbed areas including dikes and ditches within 24 hours of completion to minimize erosion and soil transport, provided however, that stabilization measures specified herein do not have to be initiated in the event that construction activities will resume on that portion of the site within 14 days from the date activities temporarily ceased. For cleared areas which may not receive permanent vegetative or other stabilization measure for 6 months or less AND a suitable growing season is not available for seedings to establish an erosion retardant cover, mulch may be applied according to the specifications below.

C. Material Specifications: Seed shall be clean, delivered in original unopened packages, and bearing an analysis of contents. Seed shall be guaranteed 95 percent pure with minimum germination rate of 85 percent. Seed mix shall be as shown in the Grassing Schedule, which is included in the Erosion, Sedimentation, and Pollution Control Plan. Alternative seed mixes may be approved by the Engineer. Fertilizer shall be commercial, chemical type, uniform in composition, free-flowing, conforming to state and federal laws, and suitable for application with equipment designed for that purpose. Fertilizer rates shall

be as shown in the Grassing Schedule, which is included in the Erosion, Sedimentation, and Pollution Control Plan. Straw mulch shall be threshed straw of oats, wheat, or rye, free from obnoxious weed seeds or obnoxious weeds, or shall be clean hay. Average stalk length shall be 6 inches. Wood waste, asphaltic emulsion, or erosion control matting such as jute, excelsior, are appropriate for temporary stabilization. Asphaltic emulsion shall be CSS-1 as manufactured by Chevron Asphalt Company.

1. The Contractor shall submit to the Engineer certificates of inspection of seed by state or federal authorities and copies of delivery invoices or other documentation of quantities of mulch and fertilizer.

2. The Contractor shall give at least 3 days' notice to the Engineer of the time and place of the planting of grass.

3. The Contractor shall keep the Engineer advised of his schedule of operations.

D. Application (Temporary Seeding): Planting and seeding shall be performed in accordance with the following requirements:

1. Soil Preparation: Prior to seeding operations, and after surface has been shaped, graded, and compacted, scarify surface to a minimum depth of 1 inch.

2. Seeding: All seedbeds shall be a minimum depth of 1 inch. Seedbeds shall be reviewed by the Engineer, prior to seeding. After soil has been scarified, apply required seed mix, uniformly with a hydro-seeder. Hydroseeding shall be as specified in Section 32 90 00 – Final Grading and Landscaping.

3. The required fertilizer mix shall be uniformly applied at the time of seeding. Fertilizer shall not be applied to a land area with a buffer zone of a Water of the United States.

4. Upon completion of the seeding operations, apply straw mulch to a reasonably uniform thickness of 1.5 to 2.5 inches in depth. Mulch shall be loose enough to permit penetration of sunlight and air circulation, but dense enough to shade ground, reduce evaporation rate, and prevent or materially reduce erosion of underlying soil. Retain straw in place by applying asphaltic emulsion at a rate of 100 gallons per acre or mechanically tack the mulch into the soil to approximately 3 inches. Equipment used for tacking shall be specially designed for this use. Mulch shall be paid for separately.

E. Application of Mulch only: For areas to receive mulch only, apply at the following rates, to the following depths, and according to the following specifications:

1. Dry Straw or Hay: Spread at a rate of 2.5 tons per acre. Apply to a depth of 6 to 10 inches. Apply uniformly and anchor as necessary.

2. Wood Waste: Spread at a rate of 6 to 9 tons per acre. Apply to a depth of 2 to 3 inches. Apply wood waste only on slopes that are 3:1 or flatter. Anchoring is not necessary.

3. Jute Matting or Excelsior Netting: Apply in accordance with manufacturer's

recommendations.

4. Asphaltic Emulsion: Apply at a rate of 1,200 gallons per acre. Apply uniformly.

F. Maintenance: In accordance with Article 3.01, all stabilized areas shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of 1/2 inch or greater. Apply additional stabilization materials as needed.

G. Polyacrylamide Stabilization: This section covers the use of the chemical anionic polyacrylamide to settle out silt and suspend solids from surface water and ground water prior to discharge. Application of polyacrylamide shall utilize a method and amount as recommended by the manufacturer and approved by the Engineer. Anionic polyacrylamide may be applied to disturbed areas in either Powder or Liquid/Emulsion form as described herein.

1. Material Specifications: Anionic polyacrylamide shall be water soluble and non-toxic. All anionic polyacrylamide products, whether in Powder or Liquid/Emulsion form, shall meet the USEPA Grade 2 classification, “Generally Regarded as Safe (GRAS).” The Contractor shall submit Material Safety Data Sheets (MSDS) to the Engineer for approval of the anionic polyacrylamide. Handling and application of the product shall adhere to the MSDS requirements and recommendations.

2. Liquid/Emulsion form of anionic polyacrylamide shall be Applied Polymer Systems, Series 600, or equal. Powder form of anionic polyacrylamide shall be Applied Polymer Systems, Series 700, or equal. Specific polymer type used shall be as per manufacturer’s recommendation for Cobb County soil classifications.

3. Application: Liquid/Emulsion form of anionic polyacrylamide shall be applied to disturbed areas at a rate of 0.5 gallons of emulsion to 1,000 gallons of water. Powder form of anionic polyacrylamide shall be applied at a rate of 4 pounds per acre of disturbed area.

4. Maintenance: Apply additional anionic Polyacrylamide as authorized or directed by the Engineer.

2.12 STRAW WITH NET TEMPORARY ROLLED EROSION CONTROL MAT (RECM)

A. The Contractor shall place straw with net temporary channel and slope RECM as shown on the Drawings. The mat shall consist of clean wheat straw from agricultural crops made into a knitted straw mat that is machine assembled. The straw shall be evenly distributed throughout the mat. The mat shall be covered with a photodegradable synthetic mesh attached to the straw with degradable thread.

B. The Contractor shall place the straw with net temporary channel and slope RECM where directed immediately after the channel or slope has been properly graded and prepared, fertilized, and seeded. If the mat is of single net construction, the netting shall be on top with the straw in contact with the soil.

C. The Contractor shall immediately repair or replaced any section of straw with net temporary channel and slope RECM which is not functioning properly or has been damaged in any way until a stable growth of grass has been established.

D. Straw with net RECM shall be North American Green S150, American Excelsior Co. Curlex I, Contech SFB1, or equal with a minimum bare soil shear stress value of 1.5 lb/ft^2.

2.13 CURLED WOOD OR COCONUT FIBER ROLLED EROSION CONTROL MAT (RECM)

A. The Contractor shall place curled wood or coconut fiber channel and slope RECM in channels or on slopes as shown on the Drawings. The mat shall consist of machine-produced mat of curled wood excelsior or coconut fiber with a majority of the fibers 6 inches or longer with consistent thickness and the fibers evenly distributed over the entire area of the mat. The top of the mat shall be covered with a biodegradable synthetic mesh. The mesh shall be attached to the curled wood excelsior or coconut fiber with photodegradable synthetic yarn.

B. The Contractor shall place the curled wood or coconut fiber channel and slope RECM where directed immediately after the channel or slope has been properly graded and prepared, fertilized, and seeded. If the mat is of single net construction, the mesh shall be on top with the fibers in contact with the soil.

C. The Contractor shall immediately repair or replace any section of curled wood or coconut fiber RECM which is not functioning properly or has been damaged in any way until a stable growth of grass has been established.

D. Curled wood or coconut fiber RECM shall be American Excelsior Curlex II, North American Green C125, Contech EFB4, or equal matting with a minimum bare soil shear stress value of 2.0 lb/ft^2.

2.14 SYNTHETIC TURF REINFORCEMENT MAT (TRM)

A. The Contractor shall place synthetic channel and slope TRM in channel or on slopes as shown on the Drawings. The mat shall consist of entangled nylon, polypropylene, or polyester monofilaments mechanically joined at their intersections forming a three-dimensional structure. The mat shall be crush-resistant, pliable, water-permeable, and highly resistant to chemical and environmental degradation.

B. The Contractor shall place the synthetic TRM where directed immediately after the channel or slope has been properly graded and prepared.

C. After the TRM has been placed, the area shall be properly fertilized and seeded as specified allowing the fertilizer and seeds to drop through the net.

D. The Contractor shall immediately repair or replace any section of TRM which is not functioning properly or has been damaged in any way until a stable growth of grass has been established.

E. Synthetic TRM shall be Enkamat 7020 as manufactured by Colbond Geosynthetics, Synthetic Industries Landlock Erosion Mat TRM 1060, Miramat TM8 as manufactured by

TC Mirafi, or equal matting with a minimum long-term vegetated shear stress value of 5.0 lb/ft^2.

2.15 TEMPORARY SLOPE DRAINS

A. Temporary slope drains shall be used to convey concentrated runoff down the face of a slope without causing erosion and shall generally be used in conjunction with temporary diversions. Temporary slope drains shall be designed, constructed, and maintained as shown on the Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in the GSWCC "Green Book". The Contractor shall provide temporary slope drains with inlet and outlet protection and associated diversion channels at all locations noted on the Drawings and other locations as may be directed by the Engineer.

B. Material Specifications: The pipe diameter for temporary slope drains shall be selected according to the GSWCC "Green Book". The pipe shall be composed of heavy-duty flexible material such as non-perforated, corrugated plastic pipe or specially designed flexible tubing.

C. Construction

1. Place slope drains on undisturbed soil or well-compacted fill. Slightly slope the section of pipe under the dike toward its outlet. Hand-tamp the soil under and around the entrance section in lifts not exceeding 6 inches.

2. Ensure that all slope drain connections are watertight and that all fill material is well-compacted. Securely fasten the exposed section of the drain with grommets or stakes spaced no more than 10 feet apart. Extend the drain beyond the toe of the slope and provide outlet protection.

D. Maintenance

1. Inspect the temporary slope drain, inlet and outlet protection, and supporting diversions weekly and after every rainfall event and promptly make any necessary repairs. When the protected area has been permanently stabilized, temporary measures may be removed, materials disposed of properly, and all disturbed areas appropriately stabilized.

2. The temporary slope drains shall be maintained to the satisfaction of the Engineer until the site has been stabilized.

2.16 FILTER BAGS

A. Temporary filter bags for use in dewatering and retaining sediment pumped out of active 'dirty' areas on the Project site where water is pumped from the work area, sent through the bag, and released from the bag to discharge on a stable floodplain or other secure area.

B. Material Specifications: The filter bag shall be made of nonwoven geotextile with a minimum surface area of 225 square feet per side sewn with a double needle matching using a high strength thread. Each sack shall have a fill spout large enough to accommodate a 4-inch-diameter discharge hose. The geotextile fabric shall meet the

following properties:

Property	Units	Value	ASTM Test Method
Weight	ounces/yard	12	D3776
Grab Tensile	pounds	300	D4632
Puncture Resistance	pounds	180	D4833
Flow Rate	gallons per minute per square foot	75	D4491
Permittivity	1/second	1.1	D4491
Mullen Burst Strength	psi	550	D3786
UV Resistance	percent	70	D4355
Apparent Opening Size (Retained)	percent	100	D4751

C. Installation: Install filter bag on a slope so incoming water flows downhill through the filter bag without creating additional erosion. Tightly attach straps to the neck of the filter bag to secure the discharge hose and prevent pumped water from escaping without being filtered. To increase the efficiency of filtration, place the bag on a bed of aggregate or hay bales to maximize water flow through the surface area of the bag.

D. Maintenance

1. The filter bag shall be considered full when it can no longer efficiently filter sediment or pass water at a reasonable rate. Flow rates will vary depending on the size of the filter bag; the type and amount of sediment discharged into the filter bag; the type of ground, rock or other substance under the bag; and the degree of the slope on which the bag lies. Under most circumstances, filter bags shall accommodate flow rates of 1,500 gallons per minute. Use of excessive flow rates or overfilling filter bag with sediment that causes rupture of the bag or failure of the hose attachment straps is not acceptable. Damage and replacement costs for improper pumping shall be the responsibility of the Contractor.

2. Full or partially full filter bags cannot be left in place and shall be removed from the Project site and legally disposed of. If allowed, the filter bag may be cut open and the contents seeded after removing visible fabric. Filter bag shall be strong enough to be lifted with added straps. Off-site disposal may be facilitated by placing the filter bag in the back of a dump truck or flatbed prior to use and allowing the water to drain from the bag in place, thereby dismissing the need to lift the filter bag.

2.17 DEWATERING SUMPS

A. The Contractor shall install temporary dewatering sump pits and conduct pumping from these pits to remove excess water while minimizing sedimentation. The sump shall filter the water being pumped to reduce sedimentation. Sedimentation may be reduced further when flow is pumped to a filter bag as indicated on the Drawings.

B. Material Specifications

1. Nonwoven Geotextile: Per Section 31 05 19 – Geotextiles

2. Stone: Clean #57 stone (0.75- to 1.5-inch-diameter maximum)

3. Hardware Cloth: 1/4-inch metal hardware cloth

4. Standpipe shall be 12- to 36-inch-diameter perforated pipe composed of high-density polyethylene, polyvinyl chloride, or corrugated metal per the Specifications and as required by Project site conditions and shall be provided with 1/2-inch x 6-inch slits or 1-inch-diameter holes located 6 inches on center. Bottom of pipe shall have a watertight cap or plate attached.

C. Installation

1. Excavate for pit construction. Pit dimensions shall be variable with the minimum diameter being twice the diameter of the standpipe.

2. A base of filter material consisting of clean gravel or #57 stone (1.5-inch-diameter maximum) shall be placed in the pit to a depth of 6 inches.

3. The standpipe shall be wrapped with hardware cloth and approved nonwoven geotextile fabric and placed in the pit on the filter material base.

4. After installing the standpipe, the surrounding pit shall then be backfilled with #57 stone to a minimum elevation of 6 inches above the anticipated high water level.

5. The standpipe shall extend a minimum of 12 inches above the anticipated standing water level.

6. Insert pumping mechanism and connect to separate filter bag if required by the Specifications or shown on the Drawings.

PART 3 -- EXECUTION

3.01 INSPECTIONS AND MAINTENANCE

A. The Contractor shall designate a Qualified Person to perform inspections required by this Section. The following areas are to be inspected and maintenance performed, if needed, at least once every 7 calendar days and within 24 hours of a rainfall event that has a precipitation of 1/2 inch or greater. Immediate action shall be taken to correct deficiencies to BMPs. The Owner reserves the right to stop all construction activities not related to maintaining BMPs until such deficiencies are repaired.

1. Disturbed areas of the construction site that have not undergone final stabilization

2. Erosion and sediment control structures

3. All locations where vehicles enter or exit the site

4. Material storage and construction laydown areas that are exposed to precipitation and have not been finally stabilized

B. In areas that have been finally stabilized, inspections and, if necessary, maintenance by Contractor shall occur at least once per month for the duration of the contract or project, whichever is longer.

C. During inspections, the following shall be observed and appropriate maintenance procedures taken:

1. The conformance to specifications and current condition of all erosion and sediment control structures

2. The effectiveness and operational success of all erosion and sediment control Measures

3. The presence of sediments or other pollutants in storm water runoff at all runoff discharge points

4. If reasonably accessible, the presence of sediments or other pollutants in receiving Waters

5. Evidence of off-site tracking at all locations where vehicles enter or exit the site

D. The Contractor shall be responsible for preparation of the inspection reports as required by and in accordance with the requirements of the NPDES Permit. Completed inspection reports shall be kept on-site with the Contract Documents and submitted to the Engineer on a monthly basis. The Contractor shall repair deficiencies within 24 hours of inspection.

3.02 MONITORING AND REPORTING

A. Monitoring: The Contractor shall be responsible for the implementation of the monitoring program defined in the Plan as required by the NPDES Permit. The implementation must comply with EPD guidelines as set forth in the most recent version of the NPDES Permit.

B. Reporting: The Contractor shall prepare and submit a summary of the monitoring results to the Engineer and the EPD as required in the NPDES Permit (if the information is not required to be electronically submitted, it shall be submitted to: Mountain District – Cartersville Office, Georgia Environmental Protection Division, P.O. Box 3250, Cartersville, GA 30120-1705, 770.387.4900). The Owner reserves the right to use its own resources to duplicate monitoring and verify the work required by the Contractor under this Section.

D. The Contractor shall provide and pay for stormwater outfall sampling and analytical testing as described on the Drawings and as may be required by the NPDES Permit.

3.03 REMOVAL OF TEMPORARY SEDIMENT CONTROL STRUCTURES

A. At such time that temporary erosion and control structures are no longer required under

this item, the Contractor shall notify the Engineer of its intent and schedule for the removal of the temporary structures and obtain the Engineer's approval in writing prior to removal. Once the Contractor has received such written approval from the Engineer, the Contractor shall remove, as approved, the temporary structures and all sediments accumulated at the removed structure shall be returned upgrade. In areas where temporary control structures are removed, the site shall be left in a condition that will restore original drainage. Such areas shall be evenly graded and seeded as specified in Section 32 90 00 – Final Grading and Landscaping.

3.04 NOTICE OF TERMINATION

A. When all construction activities have ceased, final stabilization has been implemented by the Contractor, and the site is in compliance with the NPDES Permit, the Contractor shall electronically complete and submit a Notice of Termination to Georgia EPD through GEOS in accordance with the requirements of the NPDES Permit. Submittal shall be coordinated with Owner and Engineer.

END OF SECTION

SECTION 31 35 00
SLOPE PROTECTION

EROSION CONTROL LINING SYSTEM SPECIFICATION
UNIFORM SECTION US400 - PET FABRIC FORMED CONCRETE

PART 1.0: GENERAL

1.1 Scope of Work

The work shall consist of furnish all labor, materials, equipment, and incidentals required and perform all operations in connection with the installation of the fabric formed concrete erosion control lining systems in accordance with the lines, grades, design, and dimensions shown on the Contract Drawings and as specified herein. If the contractor is inexperienced, then the fabric formed concrete manufacturer's representative shall provide on-site technical assistance at the beginning of the installation for a length of time the contractor is sufficiently experienced to complete the remaining installation.

1.2.1 Description

The work shall consist of installing an unreinforced concrete lining by positioning specially woven, double-layer synthetic forms on the surface to be protected and filling them with a pumpable fine aggregate concrete (structural grout) in such a manner as to form a stable lining of required thickness, weight and configuration.

1.3 Referenced Documents

1.3.1 American Society for Testing and Materials (ASTM)

ASTM C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 94	Standard Specification for Ready-Mixed Concrete
ASTM C 109	Standard Test Method for Compressive Strength Grout (Using 2-inch Cube Specimens or Grout Prisms)
ASTM C 150	Standard Specification for Portland Cement
ASTM C 260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
ASTM C 618	Standard Specification for Coal Fly Ash and Calcined Natural Pozzolan for Use in Concrete
ASTM C 685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 1019	Standard Test Method for Sampling and Testing Grout
ASTM C 1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM C 1603	Standard Test Method for Measurement of Solids in Water
ASTM D 2061	Standard Test Method of Strength of Zippers
ASTM D 2256	Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method
ASTM D 4354	Practice for Sampling of Geotextiles for Testing
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D 4533	Standard Test Method for Trapezoidal Tearing Strength of Geotextiles
ASTM D 4595	Test Method for Tensile Properties of Geotextiles by the Wide Width Strip Method
ASTM D 4632	Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)
ASTM D 4751	Test Method for Determining Apparent Opening Size for a Geotextile
ASTM D 4759	Practice for Determining the Specification Conformance of Geotextiles
ASTM D 4873	Standard Guide for Identification, Storage, and Handling of Geotextiles
ASTM D 4884	Test Method for Seam Strength of Sewn Geotextiles
ASTM D 5199	Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
ASTM D 5261	Test Method for Measuring Mass per Unit Area of Geotextiles
ASTM D 6241	Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 2-inch [50-mm] Probe
ASTM D 6449	Standard Method for Flow of Fine Aggregate Concrete for Fabric Formed Concrete

1.4 Terminology

For the purpose of these specifications, the following definitions shall apply:

1.4.1 Compaction:

The densification of a soil by means of mechanical manipulation. Refer to Section 31 00 01 Earthwork.

1.4.2 Subgrade:

The ground surface usually specially prepared against which lining shall be placed. In cases where lining is to be retained the same shall be considered as subgrade.

1.4.3 Hydrotex™ Fabric Form:

The fabric forms are constructed of woven, double-layer synthetic fabric. HYDROTEX linings are installed by positioning fabric forms over the areas to be protected and then pumping, high-strength, fine aggregate concrete into the forms. The fabric forms can be placed and filled either underwater or in-the-dry. The high-strength, fine aggregate concrete is used in place of conventional concrete because of its pumpability, high-strength, impermeability, and absorption resistance.

1.4.4 Hydrotex™ Uniform Section (US) Lining:

Hydrotex Uniform Section linings provide an erosion resistant, impermeable concrete lining having a brick pattern surface and a relatively low coefficient of hydraulic friction in order to maintain optimum water velocities. The thickness and weight of the lining is controlled by spacer cords.

1.4.5 Baffle:

Baffles are flow-directing vertical geotextile walls constructed between fabric form sections layers. Baffles are an integral part of the fabric form design. Baffles are designed to support the panel section, determine the concrete area of the section and direct the flow of fine aggregate concrete for maximum efficiency.

1.4.6 Slide Fastener (Zipper):

A zipper or zipper like devise having two grooved plastic edges joined by a sliding tab or pull.

1.5 Submittals

1.5.1 The Contractor shall furnish the fine aggregate concrete manufacturer's certificates of compliance, mix design, fine aggregate gradation and fineness modulus for the fine aggregate concrete.

1.5.2 The Contractor shall furnish the fabric form manufacturer's certificates of compliance for the fabric forms. The Contractor shall also furnish the manufacturer's specifications, literature, shop drawings for the layout of the concrete lining panels, and any recommendations, if applicable, that are specifically related to the project.

1.5.3 Alternative fabric formed concrete lining materials may be considered. Such materials must be pre-approved in writing by the Engineer prior to the bid date. Alternative material packages must be submitted to the Engineer a minimum of fourteen (14) days prior to the bid date. Submittal packages must include, as a minimum, the following:

Material testing reports prepared by a certified geotextile laboratory attesting to the alternative fabric form material's compliance with this Specification. Material laboratory testing shall have been performed within ninety (90) days of the bid date.

PART 2:.0 PRODUCT

2.1 General - Fabric Formed Concrete Lining

Fabric formed concrete lining shall be Uniform Section (US400) type and have a finished average thickness of 4 inches, a nominal mass per unit area of 45 lb/ft^2, and a comparatively uniform section with a brick pattern surface appearance. The shear resistance of the concrete lining shall be a minimum of 14 lb/ft^2, as demonstrated by full scale flume testing.

2.2 Fabric Forms

The fabric forms for casting the concrete lining(s) shall be as specified, HYDROTEX® Uniform Section (US400) fabric forms as manufactured by:

Synthetex, LLC; 5550 Triangle Parkway, Suite 220 Peachtree Corners, Georgia 30092
Tel: 800.253.0561 or 770.399.5051
E-Mail: info@synthetex.com

The fabric forms shall be composed of synthetic yarns formed into a woven fabric. Yarns used in the manufacture of the fabric shall be composed of polyester. Forms shall be woven with a minimum of 50% textured yarns (by weight). Partially-oriented (POY), draw-textured, and/or staple yarns shall not be used in the manufacture of the fabric. Each layer of fabric shall conform to the physical, mechanical and hydraulic requirements Mean Average Roll Values listed in Table 1.0. The fabric forms shall be free of defects or flaws which significantly affect their physical, mechanical, or hydraulic properties.

Table 1.0 PROPERTY REQUIREMENTS – HYDROTEX FABRIC [1, 2]

	Test Method	**Units**	**MARV**
Physical Properties			
Composition of Yarns	-	-	Polyester
Mass Per Unit Area (double-layer)	ASTM D 5261	oz/yd^2	13
Thickness (single-layer)	ASTM D 5199	mils	15
Mill Width (Woven)		inch	84
Mechanical Properties			
Wide-Width Strip Tensile Strength - MD | TD	ASTM D 4595	lbs/inch	300 **|** 350
Elongation at Break - MD **|** TD - Max.		%	15 **|** 15
Trapezoidal Tear Strength - MD | TD	ASTM D 4533	lbs	150 **|** 175
CBR Puncture Strength	ASTM D 6241	lbs	1250
Mullen Burst Strength	ASTM D 3786 (Mod.)	psi	500
	Test Method	**Units**	**MARV Range**
Hydraulic Properties			
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Standard Sieve	30 - 40
Flow Rate	ASTM D 4491	gal/min/ft^2	30 - 55

Notes:

1. Conformance of fabric to specification property requirements shall be based on ASTM D 4759.

2. All numerical values represent minimum average roll values (i.e., average of test results from any sample roll in a lot shall meet or exceed the minimum values). Lots shall be sampled according to ASTM D 4354.

2.2.1 Fabric forms shall consist of double-layer woven fabric joined together by spaced, interwoven cords of uniform length to form a concrete lining of the specified average thickness. The cords shall be interwoven

between the two layers of fabric, in parallel pairs, so that the two (2) cords together in the top layer and two (2) cords together in the bottom layer cross between layers at drop points. Each cord shall have a minimum breaking strength of 160 lbf when tested in accordance with ASTM D 2256.

2.2.2 Mill widths of fabric shall be a minimum of 84 inches. Each selvage edge of the top and bottom layers of fabric shall be reinforced for a width of not less than 1.35 inches by adding a minimum of 6 warp yarns to each selvage construction. Mill width rolls shall be cut to the length required, and the double-layer fabric separately joined, bottom layer to bottom layer and top layer to top layer, by means of sewing thread, to form multiple mill width panels with sewn seams on not less than 80-inch centers.

2.2.3 Fabric form panels shall be factory-sewn, by jointing together the layers of fabric, top layer to top layer and bottom layer to bottom layer, into predetermined custom sized panels. Sewn seams shall be downward facing as shown on the Contract Drawings. All sewn seams and zipper attachments shall be made using a double line of U.S. Federal Standard Type 401 stitch. All seams sewn shall be not less than 100 lbf/inch when tested in accordance with ASTM D 4884. Both lines of stitches shall be sewn simultaneously and be parallel to each other, spaced between 0.25 inches to 0.75 inches apart. Each row of stitching shall consist of 4 to 7 stitches per inch. Thread used for seaming shall be polyester.

2.2.4 Baffles shall be installed at predetermined mill width intervals to regulate the distance of lateral flow of fine aggregate concrete. The baffles shall be designed to maintain a full concrete lining thickness along the full length of the baffle. The baffle material shall be nonwoven filter fabric. The grab tensile strength of the filter fabric shall be not less than 180 lbf/inch when tested in accordance with ASTM D 4632.

2.2.5 The fabric forms shall be kept dry and wrapped such that they are protected from the elements during shipping and storage. If stored outdoors, they shall be elevated and protected with a waterproof cover that is opaque to ultraviolet light. The fabric forms shall be labeled as per ASTM D 4873.

2.2.6 The Contractor shall submit a manufacturer's certificate that the supplied fabric forms meet the criteria of these Specifications, as measured in full accordance with the test methods and standards referenced herein. The certificates shall include the following information about each fabric form delivered:

Manufacturer's name and current address;
Full product name;
Style and product code number;
Form number(s);
Composition of yarns; and
Manufacturer's certification statement.

2.3 Fine Aggregate Concrete

Fine aggregate concrete consists of a mixture of Portland cement, fine aggregate (sand) and water, so proportioned and mixed as to provide a pumpable fine aggregate concrete.

The water/cement ratio of the fine aggregate concrete shall be determined by the ready-mix manufacturer, but generally should be on the order of 0.65 to 0.70. The pumping of fine aggregate concrete into the fabric forms causes a reduction in the water content by filtering excess mixing water through the permeable fabric. The reduction of mixing water substantially improves the water/cement ratio of the in-place fine aggregate concrete thereby increasing its strength and durability. The sand/cement ratio should be determined by the ready-mix manufacturer and should be on the order of 2.4:1.

The consistency of the fine aggregate concrete delivered to the concrete pump should be proportioned and mixed as to have a flow time of 9-15 seconds when passed through the 19 mm orifice of the standard flow cone that is described in ASTM C6449-99. Additional Pozzolan and/or admixtures may be used with the approval of the Engineer-in-charge. The water/cement ratio varies with the exact granulometry of the fine aggregate (sand) and should be determined by the ready-mix manufacturer using the above referenced flow cone.

The Contractor should demonstrate the suitability by placing the proposed fine aggregate concrete mix into three (3) 2-inch concrete cubes or grout prisms. The mix should exhibit a minimum compressive strength of 3500 psi at 28 days, when made and tested in accordance ASTM C109/C109M-13 and ASTM C 1019.

With a typical loss of approximately 15% of the total mixing water, 27 ft^3 of pumpable fine aggregate

concrete will reduce to approximately 25 ft^3 of hardened concrete. The mixing water reduction will also result in an increase of approximately 8% in the sand and cement per cubic foot of concrete. The range of fine aggregate concrete mix proportions provided in Table 2.0 has been developed under a variety of field conditions.

Table 2.0 Typical Range of Mix Proportions

Material	Mix Proportions lb/yd^3	After Placement Mix Proportions lb/yd^3
Cement	750-850	805-915
Sand	2120-2030	2290-2190
Water	540-555	460-470
Air	As Required	As Required

2.3.1 Components

2.3.1.1 Portland Cement

Portland cement should conform to ASTM C 150/150M, Type I, II or V. Pozzolan grade fly ash may be substituted for up to 35% of the cement as an aid to pumpability. (The pumpability of fine aggregate concrete mixes containing course sand is improved by the addition of fly ash.) Pozzolan, if used, should conform to ASTM C 618, Class C, F or N.

2.3.1.2 Fine Aggregate (sand)

Fine aggregate should consist of suitable clean, hard, strong and durable natural or manufactured sand. It should not contain dust, lumps, soft or flaky materials, mica or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack any embedded steel, neoprene, rubber, plastic, etc. Motorized sand washing machines should be used to remove impurities from the fine aggregate. Fine aggregate having positive alkali-silica reaction should not be used. All fine aggregates should conform to ASTM C33/C33M-13. The fine aggregate should not have more than 45% passing any sieve and retained on the next consecutive sieve of those shown in Table 3.0. The fineness modulus of fine aggregate should neither be less than 2.3 nor greater than 3.1. Fine aggregate with grading near the minimum for passing the No. 50 and No. 100 sometimes have difficulties with workability or pumping. The additions of entrained air, additional cement, or the addition of an approved mineral admixture to supply the deficient fines, are methods used to alleviate such difficulties.

ASTM C33/C33M-13 defines the requirements for grading and quality of fine aggregate for use in fine aggregate concrete and is for use by a contractor as part of the purchase document describing the material to be furnished.

Table 3.0 Grading Requirement for Fine Aggregate

Sieve	Percent by Weight Passing the Sieve
9.5-mm (3/8-in.)	100
4.75-mm (No. 4)	95 to 100
2.36-mm (No. 8)	80 to 100
1.18-mm (No. 16)	50 to 85
600-µm (No. 30)	25 to 60
300-µm (No. 50)	5 to 30
150-µm (No. 100)	0 to 10
75-µm (No. 200)	0 to 3

Fine aggregate failing to meet these grading requirements can be utilized provided that the supplier can demonstrate to the specifier that fine aggregate concrete of the class specified, made with fine aggregate

under consideration, will have relevant properties at least equal to those of fine aggregate concrete made with same ingredients, with the exception that the referenced fine aggregate will be selected from a source having an acceptable performance record in similar fine aggregate construction.

2.3.1.3 Water

Water used for mixing and curing should be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete.

Potable water is permitted to be used as mixing water in fine aggregate concrete without testing for conformance with the requirements of ASTM C1602/C1602M-12.

ASTM C1602/C1602M-12 covers the compositional and performance requirements for water used as mixing water in hydraulic cement fine aggregate concrete. It defines sources of water and provides requirements and testing frequencies for qualified individual or combined water sources.

2.3.2 Plasticizing and Air Entraining Admixtures

Grout fluidifier, water reducing or set time controlling agents may be used as recommended by their manufacturers to improve the pumpability and set time of the fine aggregate concrete.

Any air entraining agent or any other admixture may be used, as approved, by the Engineer-in-charge to increase workability, to make concrete impervious and more durable. Air entraining admixture should conform to ASTM C494/C494M and ASTM C260/C260M, respectively. Mixes designed with 5% to 8% air content will improve the pumpability of the fine aggregate concrete, freeze-thaw and sulfate resistance of the hardened concrete.

2.4 Ready-Mixed Concrete

The basis of standard specifications for ready-mixed concrete should be ASTM C94/C94M-13a.

2.4.1 Ordering

The contractor should require the manufacturer to assume full responsibility for the selection of the proportions for the concrete mixture, the contractor should also specify the following:

1. Requirements for compressive strength as determined on samples taken from the transportation unit at the point of discharge. Unless otherwise specified the age at test should be 28 days.

2. That the manufacturer, prior to the actual delivery of the fine aggregate concrete, furnish a statement to the contractor, giving the dry mass of cement and saturated surface-dry-mass of fine aggregate and quantities, type, and name of admixtures (if any) and the water per cubic yard or cubic metre of fine aggregate concrete that will be used in the manufacture. The manufacturer should also furnish evidence satisfactory to the contractor that the materials to be used and proportions selected will produce fine aggregate concrete of the quality specified.

2.4.2 Mixing and Delivery

Ready-mixed fine aggregate concrete should be mixed and delivered to the point of discharge by means of one of the following combinations of operation:

Central-Mixed Concrete is mixed completely in a stationary mixer and transported to the point of delivery in a truck agitator, or a truck mixer operating at agitating speed, or in non-agitating equipment meeting the requirements of Section 13 of ASTM C94/C94M-13a. The acceptable mixing time for mixers having capacity of 1 yd^3 or less is one (1) minuet. For mixers of greater capacity, this minimum should be increased 15 seconds for each cubic yard [cubic metre] of fraction thereof of additional capacity.

Shrink-Mixed Concrete—Concrete that is first partially mixed in a stationary mixer, and then completely in a truck mixer, should conform to the following: The time for the partial mixing should be the minimum required to intermingle the ingredients. After transfer to a truck mixer the amount of mixing at the designated mixing speed will be that necessary to meet the requirements for uniformity of concrete.

Truck-Mixed Concrete—Concrete that is completely mixed in a truck mixer, 70 to 100 revolutions at the mixing speed designated by the manufacturer to produce the uniformity of concrete.

No water from the truck water system should or elsewhere should be added after the initial introduction of mixing water for the batch except when on arrival to the project site the flow rate of the fine aggregate concrete is less than 9 seconds. If the flow rate is less than 9 seconds obtain the desired flow rate within 9 to 15 seconds with a one-time addition of water. A one-time addition of water is not prohibited from being several distinct additions of water provided that no fine aggregate concrete has been discharged except for flow testing. All water additions should be completed within 15 minutes from the start of the first water addition. Such addition should be injected into the mixer under such pressure and direction of flow to allow for proper distribution within the mixer. The drum should be turned an additional 30 revolutions, or more if necessary, at mixing speed to ensure that a homogenous mixture is attained. Water should not be added to the batch at any later time.

Discharge of fine aggregate concrete should be completed within 1 1/2 hours after the introduction of mixing water to the cement and fine aggregate. This limitation may be waived by the contractor if concrete is of such flow after 1 1/2 hours time has been reached that it can be placed, without the addition of water to the batch. In hot weather, or under conditions contributing to rapid stiffening of the fine aggregate concrete, a time less than 1 1/2 hours is permitted to be specified by the contractor. *Depending on the project requirements the technology is available to the manufacture to alter fresh fine aggregate properties (such as setting time or flow.) On some projects the manufacturer may request changes to certain fresh fine aggregate concrete properties due to the distance or projected transportation time between the batch plant and the point of delivery.*

Fine aggregate concrete delivered in cold weather should have the minimum temperature indicated in Table 4.0. The maximum temperature of fine aggregate concrete produced with heated aggregate, heated water, or both, should at no time during its production or transportation exceed 90 °F.

Table 4.0 Minimum Fine Aggregate Temperature as Placed

Section Size, inch	Temperature, min, °F
< 12	55
12—36	50

2.4.3 Sampling for Uniformity

The fine aggregate concrete should be discharged at the normal operating rate for the mixer being tested, with care being exercised not to obstruct or retard the discharge by an incompletely opened gate or seal. As the mixer is being emptied, individual samples should be taken after discharge of approximately 15% and 85% of the load. *No samples should be taken before 10% or after 90% of the batch has been discharged. Due to the difficulties of determining the actual quantity of fine aggregate discharged, the intent is to provide samples that are representative of widely separated portions, but not the beginning and end of the load.*

2.4.4 Batch Ticket Information

The manufacturer of the concrete should furnish to the contractor with each batch of fine aggregate concrete before unloading at the site, a delivery ticket with the following information:

- Name of ready-mix company and batch plant, or batch plant number.
- Serial number of ticket,
- Date,
- Truck number,
- Specific designation of job (name and location),
- Specific call or designation of the concrete in conformance with that employed in project specifications,
- Amount of fine aggregate concrete in cubic yards,
- Time loaded or of first mixing of cement and fine aggregate, and
- Amount of water added to the fine aggregate concrete by the contractor, at site, or the contractor's designated representative and their initials.

The following information, for certification purposes, required by the project specifications should be furnished:

- Type, brand, and amount of cement,
- Class, brand, and amount of coal fly ash, or raw or calcined natural pozzolans,
- Type, brand, and amount of admixtures.
- Source and amount of each metered or weighted water,
- Information necessary to calculate the total mixing water. Total mixing water includes water on fine aggregates, batch water (metered or weighted) including ice batched at the plant, wash water retained in the mixing drum, and water added by the truck operator from the mixer tank,
- Amount of fine aggregate,
- Ingredients certified as being previously approved, and
- Signature or initials of manufacturer's' representative.

2.3 **Geotextile Filter Fabrics**

2.3.1 Refer to Specification 31 05 19 Geotextiles.

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PART 3.0: DESIGN REQUIREMENTS (NOT USED)

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PART 4.0: CONSTRUCTION AND INSTALLATION REQUIREMENTS

4.1 Site Preparation - Grading

4.1.1 Areas on which fabric forms are to be placed shall be constructed to the lines, grades, contours, and dimensions shown on the Contract Drawings. The areas shall be graded and uniformly compacted to a smooth plane surface with an allowable tolerance of plus or minus 0.2 feet from bottom grade, as long as ponding does not occur, and plus or minus 0.2 foot from a side slope grade as long as humps or pockets are removed.

4.1.2 The areas shall be free of organic material and obstructions such as roots and projecting stones and grade stakes shall be removed. Where required by the Contract Specifications, soft and otherwise unsuitable subgrade soils shall be identified, excavated and replaced with select materials in accordance with the Contract Specifications. Where areas are below the allowable grades, they shall be brought to grade by placing compacted layers of select material. The thickness of layers and the amount of compaction shall be as specified by the Engineer.

4.1.3 Excavation and preparation of aprons as well as anchor, terminal or toe trenches shall be done in accordance with the lines, grades, contours, and dimensions shown on the Contract Drawings.

4.1.4 The terminal edges of the fabric form lining should be keyed into the subgrade to the lines, grades, and dimensions shown on the Contract Drawings.

4.2 Inspection

Immediately prior to placing the fabric forms, the prepared area shall be inspected by the Engineer, and no forms shall be placed thereon until the area has been approved.

4.3 Geotextile Filter Fabric Placement

4.3.1 The geotextile filter fabric shall be placed directly on the prepared area, in intimate contact with the subgrade, and free of folds or wrinkles. The geotextile filter fabric shall be placed so that the upstream roll of fabric overlaps the downstream roll. The longitudinal and transverse joints will be overlapped at least two (2) feet. The geotextile will extend at least one (1) foot beyond the top and bottom concrete lining termination points, or as required by the Engineer.

4.3.2 A geotextile filter fabric, as specified elsewhere, shall be placed on the graded surface approved by the Engineer.

4.4 Fabric Form Placement

4.4.1 Factory assembled fabric form panels shall be placed over the geotextile filter fabric and within the limits shown on the Contract Drawings. Perimeter termination of the fabric forms shall be accomplished through the use of anchor, flank and toe trenches, as shown on the Contract Drawings. When placing panels an allowance for approximately 10% contraction of the form in each direction which will occur as a result of fine aggregate concrete filling. The contractor shall gather and fold the additional slope direction fabric form in the anchor trench to be secured in such a manners as to be gradually released as fabric forms contract during filling. The contractor shall gather the additional transverse direction fabric form at each baffle for self release during filling.

4.4.2 Adjacent fabric form panels shall be joined in the field by means of sewing or zippering closures. Adjacent panels shall be joined top layers to top layer and bottom layer to bottom. All field seams shall be made using two lines of U.S. Federal Standard Type 101 stitches. All sewn seams shall be downward facing.

4.4.3 When conventional joining of fabric forms is impractical or where called for on the Contract Drawings, adjacent forms may be overlapped a minimum of 3 ft to form a lap joint, pending approval by the Engineer. Based on the predominant flow direction, the upstream form shall overlap the downstream form. In no case shall simple butt joints between forms be permitted. Simple butt joints between panels shall not be allowed.

4.4.4 Expansion joints shall be provided as shown on the Contract Drawings, or as specified by the Engineer.

4.4.5 Immediately prior to filling with fine aggregate concrete, the assembled fabric forms shall be inspected by the Engineer, and no fine aggregate concrete shall be pumped therein until the fabric seams have been approved. At no time shall the unfilled fabric forms be exposed to ultraviolet light (including direct sunlight) for a period exceeding five (5) days.

4.5 Fine Aggregate Concrete Placement

4.5.1 Following the placement of the fabric forms over the geotextile filter fabric, fine aggregate concrete shall be pumped between the top and bottom layers of the fabric form through small slits to be cut in the top layer of the fabric form or manufacturer supplied valves. The slits shall be of the minimum length to allow proper insertion of a filling pipe inserted at the end of a 2-inch I.D. concrete pump hose. Fine aggregate concrete shall be pumped between the top and bottom layers of fabric, filling the forms to the recommended thickness and configuration.

Holes in the fabric forms left by the removal of the filling pipe shall be temporarily closed by inserting a piece of fabric. The fabric shall be removed when the concrete is no longer fluid and the concrete surface at the hole shall be cleaned and smoothed by hand.

4.5.2 Fine aggregate concrete coverage for US400 shall net 75 ft^2/yd^3 (see Section 2.3).

4.5.3 Fine aggregate concrete shall be pumped in such a manner that excessive pressure on the fabric forms is avoided. Consultation with the fabric form manufacturer with regard to the selection of grout/concrete pumps is recommended.

4.5.4 Cold joints shall be avoided. A cold joint is defined as one in which the pumping of the fine aggregate concrete into a given section of form is discontinued or interrupted for an interval of forty-five (45) or more minutes.

4.5.5 The sequence of fine aggregate concrete shall be such as to ensure complete filling of the fabric formed concrete lining to the thickness specified by the Engineer. The flow of the fine aggregate concrete shall first be directed into the lower edge of the fabric form and working back up the slope, followed by redirecting the flow into the anchor trench.

4.5.6 Prior to removing the filling pipe from the current concrete lining section and proceeding to the fine aggregate concrete filling of the adjacent lining section, the thickness of the current lining section shall be measured by inserting a length of stiff wire through the lining at several locations from the crest to the toe of the slope. The average of all thickness measurements shall be not less than the specified average thickness of the concrete lining. Should the measurements not meet the specified average thickness, pumping shall continue until the specified average thickness has been attained.

4.5.7 Excessive fine aggregate concrete that has inadvertently spilled on the concrete lining surface shall be removed. The use of a high-pressure water hose to remove spilled fine aggregate concrete from the surface of the freshly pumped concrete lining shall not be permitted.

4.5.8 Foot traffic will not be permitted on the freshly pumped concrete lining when such traffic will cause permanent indentations in the lining surface. Walk boards shall be used where necessary.

4.5.9 After the fine aggregate concrete has set, all anchor, flank and toe trenches shall be backfilled and compacted flush with the top of the concrete lining. The integrity of the trench backfill must be maintained so as to ensure a surface that is flush with the top surface of the concrete lining for its entire service life. Toe trenches shall be backfilled as shown on the Contract Drawings. Backfilling and compaction of trenches shall be completed in a timely fashion to protect the completed concrete lining. No more than five hundred (500) linear feet of pumped concrete lining with non-completed anchor, anchor, flank, or toe trenches will be permitted at any time.

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SECTION 32 10 00
PAVING AND SURFACING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, equipment and materials and perform all operations in connection with the construction of asphalt concrete pavement, asphalt concrete overlay, reinforced concrete pavement, gravel roads, concrete curb and gutter, repair and reconstruction of existing asphalt concrete pavement, repair of existing gravel roads, and pavement markings complete as specified herein and as detailed on the Drawings. The Contractor shall retain the services of a materials testing consultant approved by the Engineer to perform all material testing services required per this specification.

B. All new roads including the replacement of portions of the existing roads shall be to the limits, grades, thicknesses and types as shown on the Drawings. Patches for pipe crossings and areas damaged during the construction work shall be asphalt and/or gravel, depending upon the material encountered, unless otherwise indicated.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 01, Division 02 and Division 03 of these Specifications.

1.03 RELATED SECTIONS

A. Section 31 00 01 – Earthwork

B. Section 03 30 00 – Cast-in-Place Concrete

1.04 STANDARD SPECIFICATIONS

A. Except as otherwise provided in the Specifications or on the plans, all work shall be in accordance with the Georgia Department of Transportation Standard Specifications, latest edition except that any reference to "GDOT", "Department" or "Unit" shall mean the "Owner". When reference to these Specifications is intended, the description will be GDOT Section _____ or GDOT Specifications.

B. Except with the approval of the Engineer, the placing of concrete or asphalt concrete surface paving shall be subject to the Seasonal and Weather Restrictions set forth in GDOT Specifications.

PART 2 – MATERIALS

2.01 SELECT FILL

A. The Contractor shall place select fill as necessary to complete the embankments, shoulders, subgrade foundation and replacement for removed unsuitable material in accordance with GDOT Section 812, and Section 31 00 01 – Earthwork.

2.02 GRAVEL

A. All work, including materials, associated with gravel shall be in accordance with GDOT Section 800, Coarse Aggregate.

2.03 AGGREGATE STABILIZATION

A. All work, including materials, associated with Aggregate Stabilization shall be in accordance with GDOT Section 818, Crushed Aggregate Subbase.

2.04 GRADED AGGREGATE BASE (GAB)

A. All work, including materials, associated with Graded Aggregate Base shall be in accordance with GDOT Section 815, Graded Aggregate.

2.05 ASPHALT BINDER FOR PLANT MIX

A. All work, including materials, associated with asphalt binder shall be in accordance with Section 822, Emulsified Asphalt GDOT Standard Specifications.

2.06 ASPHALT PAVEMENTS

A. All work, including materials, associated with asphalt pavement shall be in accordance with Section 400, Hot Mix Asphaltic Concrete Construction, of the GDOT Standard Specifications. Surface Course shall be 9.5 mm Superpave, Intermediate Course shall be 12.5 mm Superpave, and Base Course shall be 19 mm Superpave. Asphalt pavement mix designs shall be in accordance with Section 828 of the GDOT Standard Specifications.

B. The job mix formulas shall be delivered to the Engineer at least two (2) weeks prior to beginning paving operations.

2.07 RIGID PORTLAND CEMENT CONCRETE PAVEMENT

A. All work, including materials associated with rigid concrete pavement shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete. Class A concrete shall be used. Placement shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete and GDOT Section 430, Portland Cement Concrete Pavement.

2.08 RIGID CONCRETE PAVEMENT REINFORCING

A. Reinforcing, if specified, shall be as shown on the Structural Drawings and as specified under Section 03 21 00 – Reinforcing Steel.

2.09 CONCRETE CURB AND GUTTERS

A. Concrete shall be Class B in accordance with the requirements of Section 03 30 00 – Cast-in-Place Concrete, except that concrete shall be air-entrained to provide an air content of 6% ± 1.5%.

B. Premolded expansion joint filler for expansion joints shall conform to ASTM D 1751 and shall be 1/2-inch thick, minimum.

2.10 ASPHALT TACK COAT

A. All work, including materials, associated with asphalt tack coat shall be in accordance with Section 413, Bituminous Tack Coat, of the GDOT Standard Specifications.

PART 3 – EXECUTION

3.01 SUBGRADE

A. The subgrade, where shown on the Drawings, shall be aggregate stabilized by the addition and mixing of coarse aggregate with the top 3-inches of subgrade in accordance with GDOT Section 304. Aggregate stabilization shall be applied to the subgrade at a rate of 300-pounds per square yard. Following the application of stabilizer aggregate, the subgrade shall be formed true to crown and grade, and shall be compacted with a minimum of four (4) passes of a 15-ton vibratory roller to conform to the maximum densities determined by AASHTO T99 Standard Specifications.

3.02 BASE COURSE

A. The finished base course of all paving shall be ABC and shall be of the thickness shown on the Drawings, formed true to crown and grade. Gravel roads, including repair to existing gravel roads shall be ABC and shall be of the thicknesses shown on the Drawings, formed true to crown and grade. No fill material except new ABC shall be placed on top of existing gravel.

3.03 ASPHALT BASE COURSE (OR INTERMEDIATE COURSE)

A. Asphalt Concrete Base (or Intermediate) Course shall be placed in accordance with GDOT Standard Specifications Section 400. Asphalt Concrete Base (or Intermediate) Course shall be compacted in accordance with GDOT Standard Specification 400. Thicknesses shall be as shown on the Drawings.

3.04 ASPHALT CONCRETE SURFACE COURSE

A. Prior to placement of the asphalt concrete surface course, the base/intermediate course shall be inspected for damage or defects and repaired to the satisfaction of the Engineer. The surface of the base/intermediate course shall be approved by the Engineer.

B. The asphalt tack coat shall be applied to the surface of the approved base/binder course as described in GDOT Section 400. Equipment for applying the tack coat shall be power-oriented pressure spraying or distributing equipment suitable for the materials to be applied and approved by the Engineer.

C. The Asphalt Concrete Surface Course shall be placed and compacted on the base/intermediate course in layers not to exceed 2-inches and at the rate of 110-pounds per square yard per inch. Surface Course shall be compacted in accordance with GDOT Standard Specification 400. Thicknesses shall be as shown on the Drawings.

3.05 RIGID PORTLAND CEMENT CONCRETE

A. The subgrade and base course beneath portland cement concrete pavement shall be prepared in accordance with the applicable Sections of these Specifications and referenced Standard Specifications, except that the Contractor shall use an approved automatically controlled fine grading machine to produce final subgrade and base surfaces meeting the lines, grades, and cross sections (thicknesses) shown on the Drawings or established by the Engineer.

B. The surface of the base shall be damp at the time the concrete is placed. The Contractor shall sprinkle the base when necessary to provide a damp surface. The Contractor shall satisfactorily correct all soft areas in the subgrade or base prior to placing concrete.

C. Hauling over the base course shall not be allowed except where specifically permitted by and in writing by the Engineer. The Engineer may allow equipment dumping concrete to operate on the base to the extent and under the conditions the Engineer deems necessary to facilitate placing and spreading the concrete.

D. Installation of the rigid concrete pavement shall be in accordance with the details shown on the Drawings and Division 3 - Concrete. The rigid concrete pavement shall cure a minimum of ten (10) calendar days and until the concrete has attained a minimum flexural strength of 550 psi as indicated by flexural strength testing. The Contractor shall coordinate and pay for all flexural strength testing with a minimum of four (4) 6-inch by 6-inch by 20-inch beams for every fifty (50) cubic yards of pavement concrete installed.

E. Contraction joints shall be spaced at intervals as shown on the Drawings. Transverse contraction joints shall be formed by an approved joint insert. Expansion joints shall be placed when the pavement abuts a structure using 1-inch expansion joint material (filler) and sealant as specified herein.

3.06 CONCRETE CURB AND GUTTER

A. The expansion joint filler for concrete curb and gutters shall be cut to conform with the cross section of the curb. Expansion joints shall be spaced at intervals of not more than 25-feet. Formed control joints shall be installed at intervals not exceeding 10 feet. Depth of joint shall be 1/3 the thickness. Curved forms shall be used where radii are indicated; straight segments shall not be permitted. Upon removal of the forms, exposed curb faces shall be immediately rubbed down to a smooth and uniform surface. No plastering shall be permitted.

3.07 UNDERGROUND UTILITY LINES

A. Where an underground utility line is beneath the new roadway, the backfilling shall be carried out with special care, and the final consolidation shall be accomplished by a vibratory roller. Construction of the roadway over the trench shall be deferred as long as practicable.

3.08 JUNCTION WITH OTHER PAVING

A. Where new asphalt concrete pavement abuts existing asphalt concrete pavement, the existing pavement shall be cut back to insure obtaining the specified compaction of the new pavement courses and interlocking adjoining courses. Existing subbase courses shall be cut back from the subgrade level of the new pavement on a one-on-one slope into the existing pavement, and the asphalt courses of the existing pavement shall be removed for an additional 6-inches back from the slope. The edge of the existing asphalt courses shall be saw cut straight and true. The faces between new and existing asphalt courses shall receive an application of tack coat.

B. Where new rigid concrete pavement abuts existing rigid concrete or asphalt concrete paving, the existing paving shall be saw cut straight and true. An expansion joint of a 1/2-inch minimum thickness with filler material and sealant shall be placed between the new concrete pavement and the existing rigid concrete or asphalt concrete paving.

3.09 ASPHALT CONCRETE OVERLAY

A. Where asphalt concrete is proposed to be placed over an existing asphalt or rigid concrete surface, the surfaces shall be thoroughly cleaned by power brooming and a tack coat shall be applied in accordance with GDOT Section 413, Bituminous Tack Coat, of the GDOT Standard Specifications, prior to installing the overlay. The overlay shall be applied in accordance with Subsections 2.06 and 3.05 and Standard Details shown on the Drawings.

END OF SECTION

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SECTION 32 90 00
FINAL GRADING AND LANDSCAPING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, equipment, and materials necessary for final grading, topsoiling, sodding, and miscellaneous site work not included under other Sections, but required to complete the work as shown on the Drawings and specified herein. Under this Section, all areas of the project site disturbed by excavation, materials storage, temporary roads, etc., shall be sodded as specified herein.

B. Final grading and landscaping shall meet the requirements of the Georgia Soil and Water Conservation Commission's Manual for Erosion & Sediment Control (Green Book), latest edition.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 25 00 – Erosion and Sedimentation Control

B. Section 32 92 23 – Sodding

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Product Data

2. Certification of all materials

PART 2 – PRODUCTS

2.01 CONTRACTOR'S RESPONSIBILITIES

A. Furnish and submit certification for the materials used as specified in the General Conditions, Division 01 and Division 02.

2.02 TOPSOIL

A. Upon completion and approval of the rough grading, the Contractor shall place the topsoil over all areas disturbed during construction under any contract except those areas which will be paved, graveled or rip rapped. Topsoil shall not be placed in a frozen or muddy condition and shall contain no toxic materials harmful to grass growth. Topsoil shall be as defined under Section 31 00 01 – Earthwork.

2.03 WATER

A. Water shall be furnished to the Contractor by the Owner from existing facilities as directed by the Engineer.

B. The Contractor shall furnish all hoses and connections necessary to complete the landscaping work.

2.04 FERTILIZER

A. Fertilizer shall be a complete commercial fertilizer with components derived from commercial sources. Fertilizer analysis shall be determined from field soil sampling in appropriate number taken by the Contractor and analyzed by the Georgia Department of Agriculture or other independent laboratory. Contractor shall furnish fertilizer in accordance with the recommendations of the Georgia Department of Agriculture and the Green Book.

B. One-quarter of the Nitrogen shall be in the form of nitrates, one-quarter in the form of ammonia salts, and one-half in the form of natural organic Nitrogen. Available Phosphoric Acid shall be free from superphosphate, bone, or tankage. Potash shall be Sulphate of Potash. Elements shall conform to the standards of Association of Official Agricultural Chemists.

C. Fertilizer shall be delivered in standard size bags marked with the weight, analysis of contents, and the name of the manufacturer. Fertilizer shall be stored in weatherproof storage areas and in such a manner that its effectiveness will not be impaired.

2.05 LIME

A. At least 50% shall pass a No. 200 U.S.S. mesh sieve. At least 90% shall pass a No. 100 U.S.S. mesh sieve and 100% shall pass a No. 10 U.S.S. mesh sieve. Total carbonates shall not be less than 80% or 44.8% Calcium Oxide equivalent. For the purpose of calculation, total carbonates shall be considered as Calcium Carbonate.

2.06 GRASS SEED

A. The Contractor shall furnish the kinds and amounts of seed to be seeded in all areas disturbed by the construction work. All seed shall be labeled to show that it meets the requirements of the Georgia Seed Law. All seed must have been tested within six (6) months immediately preceding the planting of such material on the job.

B. The inoculant for treating legume seed shall be a pure culture of nitrogen-fixing bacteria prepared specifically for the species. Inoculants shall not be used later than the date indicated on the container. The quality of the seed shall conform to the Green Book.

C. All seed shall be in conformance with Georgia Seed Law restrictions for restricted noxious weeds.

D. Seed mixtures to be used on the project are identified on the Contract Drawings.

2.07 TEMPORARY SOIL STABILIZER

A. Temporary soil stabilizers may be used in place of temporary seeding, as approved by the Owner or Engineer. The temporary agent for soil erosion control shall consist of an especially prepared plant-based or cementitious highly concentrated powder which, when mixed with water, forms a thick liquid such as "DustOut" manufactured by DustOut™, "Stabilizer" manufactured by Stabilizer Solutions, or "SoiLok™" as manufactured by Prime Resins, or equal, and having no growth or germination inhibiting factors. The agent shall be used for bare soil stabilization or hydroseeding grass seed in combination with other approved amendments resulting in a highly viscous slurry which, when sprayed directly on the soil, forms a wind and rain resistant crust.

2.08 ROLLED EROSION CONTROL MATTINGS

A. The rolled erosion control products (RECMs) shall be as specified in Section 31 25 00 – Erosion and Sedimentation Control.

2.09 RIPRAP AND HERBICIDES

A. Furnish and install sufficient quantity of landscape gravel or riprap to cover over the ground to a minimum 4-inch depth for gravel and 24-inch depth for riprap, unless otherwise noted, or indicated on the Drawings. Also furnish and apply an approved herbicide to the subgrade surface just prior to installing the landscape gravel or riprap.

B. During placing, the stone shall be graded so that the smaller stones are uniformly distributed through the mass. The Contractor may place the stone by mechanical methods, augmented by hand placing where necessary or ordered by the Engineer. The placed riprap shall form a properly graded, dense, neat layer of stone.

C. All topsoil and vegetative matter shall be removed from the subgrade surfaces prior to the application of the weed killer (herbicide) and to the placement of landscape gravel or riprap. Apply commercial-type herbicide as preemergence control of miscellaneous grasses and broadleaf weeds in granular or liquid form such as "Treflan", "Dymid", or equal. Methods and rates of application shall be in strict compliance to manufacturer's directions and acceptable to the Engineer.

D. The herbicide selected shall be safe for use around ornamental plantings, have long-lasting weed control, and shall be resistant to leaching away under excessive rainfall.

E. A second application of the herbicide shall be made on the surface of the landscape gravel or riprap sometime after the first six (6) months, but not later than 12-months. Same methods and rates apply as specified previously.

PART 3 – EXECUTION

3.01 GRADING

A. After approval of the rough grading, the Contractor shall commence his preparations of the subgrade for the various major conditions of the work as follows:

1. Bare soil for riprap area at subgrade (24-inches below final grade, or as directed by the Engineer).

2. Topsoil for lawn and road shoulder seed area - scarify 2-inch depth of subgrade (4-inches below final grade) prior to placing topsoil.

B. Final surface grading of the top-soiled, landscape graveled, and riprapped areas shall be mechanically raked or hand raked to an even finished surface alignment.

3.02 TOPSOIL

A. Topsoil shall be spread in place for quantity required for lawn and road shoulder seed areas at 4-inch consolidated depth, and sufficient quantity for certain plant beds and backfill for shrubs and trees as specified.

3.03 SEEDBED PREPARATION

A. Contractor shall prepare all areas to receive temporary or permanent seeding measures prior to planting.

B. Topsoil shall be placed in areas to be seeded and roughened with tracked equipment or other suitable measures. Slopes steeper than 3:1 may be roughened by grooving, furrowing, tracking, or stairstep grading. Slopes flatter than 3:1 should be grooved by disking, harrowing, raking, operating planting equipment on the contour.

C. Soil amendments including, but not limited to, lime and fertilizer shall be spread as necessary, and at the rates specified in this Section. Seeding shall be as per the type and rates specified in this Section. Seed shall be broadcast as soon as possible following roughening, before surface has been sealed by rainfall.

3.04 HYDROSEEDING AND GRASS ESTABLISHMENT

A. The Contractor shall grow a stand of temporary grass by hydroseeding method and permanent grass by sodding on all disturbed areas. The Contractor shall be responsible for the satisfactory growth of grass throughout the period of the one year guarantee.

B. The Contractor's work shall include the preparation of the topsoil and bare soil seed bed, application of fertilizer, limestone, mulching, inoculant, temporary soil stabilizer, watering, and all other operations necessary to provide a satisfactory growth of sod at the end of the one-year maintenance period. Areas without satisfactory sod at the end of

one (1) year shall be replanted until satisfactory growth is obtained and acceptable to the Engineer.

C. All areas to be seeded shall be done by the hydraulic seeding method including all additives and amendments required. A "Reinco", "Finn", or "Bowie" type hydromulcher with adjustable nozzles and extension hoses, or equal, shall be utilized. General capacity of tank should range from 500 to 2,500 gallons, or as approved by the Engineer.

D. Hydraulic seeding shall be carried out in three steps. Step one shall consist of the application of lime. In step two the seed mixture shall be mixed with the fertilizer, wood cellulose fiber mulch, and any required inoculants and applied to the seed bed. Step three shall consist of application of top dressing during the first spring or fall, whichever comes first, after step two.

E. Top dressing shall consist of a commercial grade fertilizer plus Nitrogen or other analysis as may be recommended by soil testing. Types and application rates of seed mixtures, lime, fertilizer, and wood cellulose fiber mulch shall be as shown in the Seeding Schedule.

F. Ingredients for the mixture and steps should be dumped into a tank of water and thoroughly mixed to a homogeneous slurry and sprayed out under a minimum of 300-350 pounds pressure, in suitable proportions to accommodate the type and capacity of the hydraulic machine to be used. Applications shall be evenly sprayed over the ground surface. The Contractor shall free the topsoil of stones, roots, rubbish, and other deleterious materials and dispose of same off the site. The bare soil, except existing steep embankment area, shall be rough raked to remove stones, roots, and rubbish over 4-inches in size, and other deleterious materials and dispose of same off the site.

G. No seeding should be undertaken in windy or unfavorable weather, when the ground is too wet to rake easily, when it is in a frozen condition, or too dry. Any bare spots shown in two to three weeks shall be recultivated, fertilized at half the rate, raked, seeded, and mulched again by mechanical or hand broadcast method acceptable to the Engineer.

H. Areas that have been manually seeded or hydroseeded with a temporary seed mixture shall be mowed to a height of less than 2inches and scarified prior to hydroseeding with the permanent seed mixture.

I. The Contractor shall provide, at his own expense, protection for all seeded areas against trespassing and damage at all times until acceptance of the work. Slopes shall be protected from damage due to erosion, settlement, and other causes and shall be repaired promptly at the Contractor's expense.

J. The Contractor shall water newly seeded areas of the lawn and road shoulder mix once a week until the grasses have germinated sufficiently to produce a healthy turf, or unless otherwise directed by the Engineer. Each watering shall provide three (3) gallons per

square yard. The Contractor shall furnish all necessary hoses, sprinklers, and connections.

K. The first and second cutting of the lawn grasses only shall be done by the Contractor. All subsequent cuttings will be done by the Owner's forces in a manner specified by the Contractor.

3.05 DITCH AND SWALE EROSION PROTECTION

A. All ditches and swales indicated on the Drawings shall be lined with a rolled erosion control matting (RECM). The area to be covered shall be properly graded and hydroseeded before the RECM is installed. Installation shall be in accordance with Section 31 25 00 – Erosion and Sedimentation Control.

3.06 MAINTENANCE

A. The Contractor shall be responsible for maintaining all seeded areas through the end of a one-year warranty period, beginning from the date of acceptance of final seeding and landscaping as determined by the Engineer. Maintenance shall include but not be limited to, annual fertilization, mowing, repair of seeded areas, irrigation, and weed control. The Contractor shall provide, at his own expense, protection for all seeded areas against trespassing and damage at all times until acceptance of the work. Slopes shall be protected from damage due to erosion, settlement, and other causes and shall be repaired promptly at the Contractor's expense.

B. Annual fertilization shall consist of an application of 500#/acre of 10-10-10 commercial grade fertilizer, or its equivalent and 60#/acre of nitrogen in early fall, or other analysis as may be determined by soil test. Annual fertilization shall be in addition to top dressing and shall be performed by the Contractor each fall season after planting until the work is substantially complete.

C. Mowing shall be scheduled so as to maintain a minimum stand height of 4-inches or as directed by the Engineer. Stand height shall be allowed to reach 8 to 10-inches prior to mowing.

D. All seeded areas shall be inspected on a regular basis and any necessary repairs or reseedings made within the planting season, if possible. If the stand should be over 60% damaged, it shall be re-established following the original seeding recommendations.

E. Weed growth shall be maintained mechanically and/or with herbicides. When chemicals are used, the Contractor shall adhere strictly to the instructions on the label of the herbicide. No herbicide shall be used without prior approval of the Engineer.

3.07 CLEANUP

A. The Contractor shall remove from the site all subsoil excavated from his work and all other debris including, but not limited to, branches, paper, and rubbish in all landscape areas, and remove temporary barricades as the work proceeds.

B. All areas shall be kept in a neat, orderly condition at all times. Prior to final acceptance, the Contractor shall clean up the entire landscaped area to the satisfaction of the Engineer.

3.08 SEEDING SCHEDULE

A. All seeding and mulching to be completed by the Contractor shall conform to the schedule shown on the Contract Drawings. Areas seeded with temporary seed mixtures shall be replanted by the Contractor at no additional cost to the Owner with permanent grassing (sod) as directed by the Engineer.

B. Application rates of seed mixtures, lime, fertilizer, mulch and top dressing are shown on the Contract Drawings.

END OF SECTION

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SECTION 32 92 23
SODDING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Preparation of subsoil, placing topsoil, fertilizing, sod installation, and maintenance as required to complete Work as shown on drawings and specified in this Section.

1.02 REFERENCES

A. ASPA (American Sod Producers Association) – Guideline Specifications to Sodding.

B. FS O-F-241 – Fertilizers, Mixed, Commercial.

1.03 DEFINITIONS

A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nut-grass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 QUALITY ASSURANCE

A. Sod Producer: Company specializing in sod production and harvesting with minimum five years of experience and certified by the State or Commonwealth in which the project is located.

B. Installer: Company approved by the sod producer.

C. Sod: Minimum age of 18 months, with root development that will support its own weight, without tearing, when suspended vertically by holding the upper two corners.

D. Submit sod certification for grass species and location of sod source.

1.05 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01 65 00 – Product Delivery Requirement.

B. Store and protect products under provisions of Section 01 66 00 – Product Storage and Protection Requirements.

C. Deliver sod on pallets. Protect exposed roots from dehydration.

D. Do not deliver more sod than can be laid within 24 hours.

1.07 MAINTENANCE SERVICE

A. Maintain installed sod until Owner has accepted Work.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sod: Nursery grown grade; cultivated grass sod; type indicated below; with strong fibrous root system, free of stones, burned or bare spots. Sod shall match existing sod.

B. Topsoil: Refer to Section 31 00 01 Earthwork.

C. Fertilizer: As recommended by sod producer or in Section 32 90 00 Final Grading and Landscaping, whichever is more conservative.

D. Water: Clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

2.02 ACCESSORIES

A. Wood Pegs: Softwood; sufficient size and length to ensure anchorage of sod on slope.

B. Wire Mesh: Interwoven hexagonal metal wire mesh of 2 size.

2.03 HARVESTING SOD

A. Machine cut sod and load on pallets.

B. Cut sod in area not exceeding one sq yd with minimum ½ inch topsoil base.

PART 3 – EXECUTION

3.01 INSPECTION

A. Verify that prepared soil base is ready to receive the work of this Section.

B. Beginning of installation means acceptance of existing site conditions.

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3.02 PREPARATION OF SUBSOIL

A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials and undesirable plants and their roots. Do not bury foreign material beneath areas to be sodded. Remove contaminated subsoil.

C. Scarify subsoil to a depth of 4 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

3.03 PLACING TOPSOIL

A. Spread topsoil to a minimum depth of 2 inches over area to be sodded.

B. Place topsoil during dry weather and on dry, unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material while spreading.

D. Grade to eliminate rough, low, or soft areas, and to ensure positive drainage.

3.04 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of topsoil and prior to installation of sod.

C. Apply fertilizer no more than 48 hours before laying sod.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.05 LAYING SOD

A. Moisten prepared surface immediately prior to laying sod.

B. Lay sod within 24 hours after harvesting to prevent deterioration.

C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.

D. Lay smooth. Align with adjoining grass areas. Place top elevation of sod 1/2 inch below adjoining paving or curbs.

E. On slopes 6 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.

F. Prior to placing sod on slopes exceeding 8 inches per foot or where indicated, place wire mesh over topsoil. Securely anchor sod in place over wire mesh and topsoil with wood pegs sunk firmly into the ground.

G. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.

H. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with roller not exceeding 150 lbs per foot of roller width.

3.06 MAINTENANCE

A. Mow grass at regular intervals to maintain at a maximum height of 2½ inches.

B. Neatly trim edges and hand clip where necessary.

C. Immediately remove clippings after mowing and trimming.

D. Water to prevent grass and soil from drying out.

E. Roll surface to remove minor depressions or irregularities.

F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

G. Immediately replace sod to areas which show deterioration or bare spots.

H. Protect sodded areas with warning signs during maintenance period.

END OF SECTION

SECTION 33 05 39.23
REINFORCED CONCRETE PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, equipment and materials in connection with the installation of exterior underground reinforced concrete pipe for sewer, low-head pressure piping, and concrete culverts and storm drains as shown on the Contract Drawings and specified herein.

B. Special care shall be exercised during delivery, distribution and storage of the pipe and fittings to prevent damage. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Storage of pipe and fittings, prior to use, shall be in such a manner as to keep the materials clean and dry.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 11 00 – Summary of Work

B. Section 31 00 01 – Earthwork

C. Section 33 05 61 – Utility Structures

D. Section 40 05 00 – Basic Mechanical Requirements.

E. Section 40 06 20 – Schedules

1.03 REFERENCES

A. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

B. ASTM C 150 - Standard Specification for Portland Cement

C. ASTM C 361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe

D. ASTM C 443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

E. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))

F. ASTM C 990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

G. ASTM C 1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations

H. ASTM C 1628 - Standard Specification for Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets

I. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

J. ASTM D 4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

K. ASTM D 4254 - Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

L. AASHTO M 43 - Standard Specification for Sizes of Aggregate for Road and Bridge Construction

1.04 SUBMITTALS

A. Furnish and submit shop drawings and certificates for the piping work as outlined in the General Conditions and Division 1.

B. Product Data – Contractor shall submit complete reinforced concrete pipe product data showing conformance to the Contract Drawings and these specifications, including, but not limited to materials used and conformance to the noted standards and specifications.

PART 2 – PRODUCTS

2.01 REINFORCED CONCRETE CULVERT AND STORM DRAIN PIPE

A. All reinforced concrete culvert and drain pipe shall be manufactured in accordance with ASTM C76, Wall Type B or C, and shall be of the class that equals or exceeds the pipe class as specified herein or as shown on the Contract Drawings. Minimum pipe laying lengths shall be four (4) feet.

B. Joints for the reinforced concrete culvert and storm drain pipe shall have bell and spigot ends with preformed flexible joint sealants meeting the requirements of ASTM C 990.

C. All pipe shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site.

2.02 BACKFILL MATERIAL

A. The material obtained from excavation of the pipe trench or elsewhere on site with a particle size not greater than 2 inches shall be used for pipe backfill in areas outside the limits of dam if they conform with the soil classes given in Table 1. Imported materials

meeting the criteria of Table 1 may also be used. Construction within limits of dam require special construction considerations and compliance with Section 31 00 01 Earthwork.

Table 1: Acceptable Backfill Material and Compaction Requirements

Soil Classifications				
Description	**ASTM D 1479**	**ASTM D 2487**	**AASHTO M 43**	**Minimum Standard Proctor Density %**
Graded or crushed, crushed stone, gravel	Class I	--	5 56	Dumped
Well-graded sand, gravels and gravel/sand mixtures, poorly graded sand, gravels and gravel/sand mixtures; little or no fines	Class II	GW GP SW SP	57 6	95%
Silty or clayey gravels, gravel/sand/silt or gravel and clay mixtures; silty or clayey sands, sand/clay or sand/silt mixtures	Class III	GM GC SM SC	Gravel and Sand (<10% fines)	95%

PART 3 – EXECUTION

3.01 INSPECTION

A. Each length of pipe and fittings delivered to the property shall be inspected by the Contractor, in the presence of the Engineer, for flaws, cracks, dimensional tolerances and compliance with the referenced Standards. The Contractor shall provide the Engineer with suitable templates or calipers for checking pipe dimensions. Only lengths of pipe and fittings accepted by the Engineer and so marked may be installed in the work.

3.02 INSTALLATION

A. The laying of reinforced concrete pipe shall conform to the applicable sections of the Concrete Pipe Handbook as published by the American Concrete Pipe Association.

B. Trenching, bedding, and backfilling shall be as specified in Division 31 of these Specifications and Details on Sheet C09 of the Contract Drawings. Under no condition shall pipe be laid in water or when trench conditions or weather are unsuitable for such work.

C. All pipes and fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists or lowered on skidways in such a manner as to avoid shock. Derricks, ropes or other suitable equipment shall be used for lowering the pipe into the trench. Pipe and fittings shall not be dropped or dumped.

D. Each pipe and fitting shall be inspected before it is lowered into the trench. The interior of the pipe and all joint surfaces shall be thoroughly cleaned and shall thereafter be maintained clean. The open ends of pipe shall be securely plugged whenever pipe laying is not in progress.

E. Pipe and fittings shall be selected so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. All joints shall be installed, made up and inspected in accordance with approved printed instructions of the manufacturer. Pipe and fittings which do not fit together to form a tight joint will be rejected.

F. Cutting of reinforced concrete pipe will be permitted only at connections to structures and be accomplished by abrasive saws. Cutting of other pipe materials shall be done only with mechanical cutters and in accordance with the manufacturer's recommendations.

G. Pipe shall be laid accurately to the lines and grades shown on the drawings or as directed by the Engineer.

H. If an adequate foundation for the pipe is not available at the desired depth, additional excavation shall be required, and the foundation brought to desired grade with suitable granular material.

I. Rock outcroppings, very soft soils such as muck, and other similar materials not providing proper foundation support shall be removed/replaced with suitable granular material.

J. Outside limits of dam, bdding material directly under the pipe invert shall be left in native condition and not compacted. Pipe shall be placed on the bedding, then backfilled under the pipe haunches before further backfill is placed.

K. Class I materials may be dumped around pipe. Voids shall be eliminated by knifing under and around the pipe or by other approved technique.

L. Inorganic silts, and gravelly, sandy, or silty clays, and other Class IV materials (not shown in Table 1) shall not be used for pipe backfill.

M. Any section of the pipe that is found defective in material, alignment, grade, joints, or otherwise, shall be satisfactorily corrected by the Contractor at no additional cost to the Owner.

3.03 COMPACTION

A. General

1. Place and assure backfill and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.

2. In no case shall degree of compaction below “Minimum Compactions” specified be accepted.

B. Compaction Requirements: Unless noted otherwise on the Drawings or more stringently by other Sections of these Specifications, comply with following trench compaction criteria:

Table 2: Minimum Compactions

Location	Soil Type	Density
Compacted Select Backfill		
All applicable areas	Cohesive soil	95 percent of maximum dry density by ASTM D698
	Cohesionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
Common Trench Backfill		
Under pavements roadways surfaces, D698 within highway rights-of-way, adjacent to retaining walls	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohesionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
Under turfed, sodded plant seeded, non-traffic areas	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohesionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254

C. Ensure backfill materials have moisture content within three (3) percent of optimum moisture content at the time of placement.

3.04 INSPECTION AND TESTING

A. General

1. The Contractor shall provide at his own expense, all labor, material, video and measuring devices, water, plugs, or other equipment necessary to perform the required tests on installed reinforced concrete pipe. All tests shall be performed in the presence of the Engineer. Disposal of water shall be through WTP’s storm drain system; disposal shall be coordinated in advance with the Owner.

B. Field Test - Visual Inspection

1. Examine structures and pipes for:

a. Physical damage.

b. Indication of displacement of pipes or structures, reinforcement, forms, or bedding.

c. Porous areas or voids.

d. Proper placement of seals, gaskets, and embedments.

e. Visible infiltration.

2. Verify structures and pipes are set to proper line, grade as per the Contract Drawings, and are plumb.

3. Verify structure and pipe dimensions and thickness match Contract Drawings.

4. The Contractor shall be responsible to provide video recording of all installed storm sewer systems at least 30 days after completion of backfill and one month before Owner or Engineer gives final acceptance for the one-year warranty. The recording shall be made using a color camera, self-propelled or other, having sufficient light to show detail of problem areas and joints. Camera speed shall not exceed 3 feet per second. If problems or concerns are seen by the operator, then the camera shall be reversed and an extended look at the area will be recorded. All recordings will have time, date, and footage displayed. Supplement the video recording with a written log or orally recorded tape log noting observations, findings, and deficiencies shown on the video tape.

   a. The video recording inspection shall be performed by an outside independent testing agency acceptable to the Owner or Engineer.

   b. The video tape and log will be given to the Engineer for review. If the Engineer finds any problems with the storm sewer, the Contractor will repair the problem and re-camera the repaired area before final acceptance will be given, at no added cost to the Owner.

   c. Video recording of storm sewer may be waived if pipe diameter is sufficient for human access, as determined by the Engineer. A log shall be developed for such inspection.

   d. One copy of the video tape and log will become permanent property of the Engineer and Owner as record.

C. Repair

1. Repair or replace any damage pipe or work found unacceptable by the Engineer at no additional cost to the Owner.

2. Repair all visible leaks.

3. Remove any concrete webs or protrusions.

4. Remove form ties and repair tie holes.

END OF SECTION

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SECTION 33 05 61
UTILITY STRUCTURES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, equipment, and tools required for the design, fabrication, delivery and installment of utility structures and appurtenances in accordance with the Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 00 01 – Earthwork

B. Section 03 15 00 – Concrete Accessories

C. Section 03 21 00 – Reinforcing Steel

D. Section 03 30 00 – Cast-in-Place Concrete

E. Section 03 40 00 – Precast Concrete

F. Section 05 56 00 – Castings

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)

2. ASTM C139 - Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes

3. ASTM C478 – Specification for Precast Reinforced Concrete Manhole Sections

4. ASTM C857 – Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

5. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

6. ASTM C990 – Specifications for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

7. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

8. ASTM C1478 - Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes, and Laterals

9. ASTM F2510 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Corrugated Dual- and Triple-Wall Polyethylene and Polypropylene Pipes

1.04 SUBMITTALS

A. Submit samples and/or Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

B. In addition to items listed in Section 03 40 00 – Precast Concrete, Shop Drawings shall include, but not be limited to:

1. Complete layout and installation Drawings and schedules with clearly marked dimensions.

2. Material certificates on all piping materials.

3. Structural design calculations sealed by a Professional Engineer registered in the State or Commonwealth in which the project is located. Design calculations for precast manholes and vaults shall include confirmation structures adequately resist flotation when they are totally empty and subjected to groundwater full height of structure.

4. Results of leakage test

PART 2 – PRODUCTS

2.01 PRECAST MANHOLES, VAULTS, AND METER BOXES

A. Precast utility structures shall be furnished with water-stops, sleeves and openings as noted on the Drawings. Box out for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes. Precast utility structures shall be watertight and conform to the requirements of ASTM C 478 and ASTM C857 with the following modifications there to:

1. Materials shall conform to Section 03 40 00 – Precast Concrete.

2. Manholes shall meet the following:

a. Manhole section shall have an internal diameter of 4'-0", unless noted otherwise. Clear lid openings shall be 24-inch diameter.

b. Minimum manhole wall thicknesses shall be 5 inches for 4-foot and 5-foot diameter manholes, 6 inches for 6-foot diameter manholes and 7 inches for 7-foot diameter manholes.

c. Manholes and utility structures shall include ballast concrete and/or other means necessary to ensure manholes resist flotation when empty and subjected to groundwater full height of structure.

d. Precast manholes and utility structures shall be as manufactured by Oldcastle, Tindall Corporation, or equal.

3. The date and name of manufacturer shall be marked inside each precast section.

4. No more than two lift holes may be cast or drilled in each section.

5. Dimensions shall be as shown on the Drawings.

6. Covers and frames shall be as specified in Paragraph 2.12.

7. Mechanical Details such as piping, electrical, and other details shall be as shown on the Drawings.

B. Joints between manhole and utility structures riser sections and at base slabs shall be groove type.

2.02 BRICK

A. Brick shall be sound, hard-burned common brick conforming to ASTM C32, Grade MS.

2.03 MORTAR

A. Masonry mortar shall be Type "S" according to ASTM C-270. CONCRETE

B. Concrete shall conform to Section 03 30 00 – Cast-in-Place Concrete.

2.04 REINFORCING

A. Reinforcing shall conform to Section 03 21 00 – Reinforcing Steel.

2.05 PRECAST CONCRETE

A. Precast concrete shall conform to Section 03 40 00 – Precast Concrete.

2.06 CONCRETE BLOCK

A. Concrete block shall be solid, rectangular concrete masonry units conforming to ASTM C139.

2.07 CASTINGS

A. Castings shall conform to Section 05 56 00 – Castings. Casting shall be of the type and size indicated on the Drawings.

2.08 STEPS

A. Steps shall be constructed of Grade 60 steel reinforcing rod (min. 1/2-inch) and completely encapsulated with a wear resistant and chemical resistant rubber.

B. Each step shall have a minimum vertical load resistance of 800 pounds and a minimum pull-out resistance of 400 pounds.

C. The steps shall have 11-inch minimum tread width and shall be placed at 16-inches on center, as shown on the Drawings.

D. Steps shall be cast in place with the concrete.

E. Steps shall only be installed as shown on the Drawings or required in the Specifications.

2.09 JOINT SEALANT

A. Joint sealant shall be a preformed flexible sealant conforming to the requirements of ASTM C990, paragraph 6.2, Butyl Rubber Sealant. Joint sealant shall be Pro-Stik Butyl Sealant by Press-Seal Corporation, Butyl-Nek Join Sealant by Henry Company, CS-102 Butyl Rubber Sealant for all Precast Structures by ConSeal Concrete Sealants, Inc., or equal.

2.10 PIPE TO MANHOLE CONNECTIONS

A. The spring set type shall have a stainless-steel interior power sleeve or expander and shall be the PSX assembly by Press-Seal Gasket Corporation, the Kor-N-Seal® | 106-406 Series assembly by National Pollution Control Systems, or QUIK-LOK Boot Connector by A-LOK Products, Inc, or equal.

B. The cast-in-place type shall conform to ASTM C1478-19 for storm drain connections between pipes, and laterals, and ASTM F2510 for storm drain connections between reinforced concrete manhole structures, and dual and triple-wall polyethylene and polypropylene pipes. Sleeves shall include stainless steel take up clamps.

C. Flexible seal assemblies shall permit at least an eight (8) degree deflection from the center line of the opening in any direction while maintaining a watertight connection.

2.11 COVERS AND FRAMES

A. Covers and frames shall comply with Section 05 56 00 – Castings and shall be provided by the utility structure manufacturer.

B. Manhole covers and frames shall meet the following requirements:

1. Locate so that there is ready access to the manhole steps

2. Clear opening shall be a minimum of 22 inches, unless otherwise indicated on the Drawings.

3. Watertight manhole frames and covers shall be suitable for 20 psi internal pressure and shall be Neenah Model R-1915, Type E or equal, cast in place.

4. Non-watertight manhole covers shall be perforated and shall be Neenah Model R-1668, or equal.

5. Storm drain grated inlet frames and grates shall be Neenah R-1878-B7G, East Jordan Iron Works V5660, or equal.

C. Frames and covers shall be identical throughout the Contract.

2.12 CONCRETE BALLAST

A. Concrete ballast shall be Class B concrete in conformance with Section 03 30 00 – Cast-in-Place Concrete. Ballast shall be provided as necessary to ensure manhole resists flotation when empty and subjected to full height groundwater conditions.

2.13 FLEXIBLE JOINT SEALER

A. Flexible joint sealer shall be a rubber ring waterstop as manufactured by Fernco Joint Sealer Co., or equal.

2.14 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to Section 03 15 00 – Concrete Accessories.

PART 3 – EXECUTION

3.01 DESIGN CRITERIA

A. Minimum structural design loading for underground precast concrete vaults shall be as indicated in ASTM C857, unless otherwise noted herein. Precast items subjected to vehicular traffic shall be designed for H-20 traffic loading. Other precast items shall be designed for a vertical live load of 300 psf.

B. Walls of precast items shall be designed for a vertical surcharge resulting in a 100 psf horizontal load.

C. Precast manholes and vaults shall be designed to resist flotation when totally empty and subjected to groundwater full height of the manhole/vault.

3.02 FABRICATION AND CASTING

A. Fabrication and casting shall conform to Section 03 40 00 – Precast Concrete and Section 03 30 00 – Cast-in-Place Concrete.

B. All base sections designated to receive concrete ballast and all electrical manholes shall extend monolithically a minimum of 6 inches beyond the outside face of the wall for the entire periphery. All other utility structures shall have a standard base.

C. Utility structures built around existing pipe shall have a cast-in-place base slab.

3.03 HANDLING, TRANSPORTING, AND STORING

A. Handling, transporting, and storing of precast items shall comply with Section 03 40 00 – Precast Concrete.

3.04 INSTALLATION

A. Installation shall conform with Section 03 40 00 – Precast Concrete and with the manufacturer's recommendations or to Section 03 30 00 – Cast-in-Place Concrete.

B. Frames and covers or grates shall be set so that tops are at elevations indicated on the Drawings or flush with finished grade where no elevation is indicated.

C. Joints between riser sections shall be sealed with joint sealant.

D. All openings in utility structures shall have flexible rubber sleeves sized to fit the connecting pipe and installed to provide watertight joints in accordance with the manufacturer's recommendations. The interior of the sleeve shall be filled with Class B concrete.

E. Openings that are too large for flexible rubber sleeves shall utilize rubber bladder seals which are expanded by water injected using a pressure pump.

F. All units shall be installed plumb and level.

G. All lift holes and joints shall be filled with non-shrink grout conforming to Section 03 60 00 – Grout, grout inside and out.

H. The manhole frames shall be set to their required elevations either with grade rings or with two or three courses of brick masonry laid around the top of the upper wall section. Such brick work shall be given a 1-inch mortar coat on the inside and out.

I. Concrete ballast shall be placed so that it bears directly on the utility structure base against the outer wall monolithically encircling the structure for the full height indicated on the Drawings. Additional ballast may be required where the depth or elevation of the structure varies from the Drawings.

J. Brick or Concrete Block

1. Brick or concrete block shall be laid with broken joints and all horizontal and vertical joints filled with cement-sand mortar. Outside of walls shall be plastered with a minimum 1-inch thick coat of cement-sand mortar troweled smooth.

K. Connection to Existing Pipe

1. Verify the diameter and invert elevation of existing pipe to be connected to new utility structures prior to beginning work on the structures.

2. Provide adequate protection to prevent damage to the existing pipe.

3. Provide adequate means for plugging and/or transferring the existing flow in the pipe to allow for the construction of inverts and grouting.

4. Cut off the existing pipe sufficiently for connection to the new structure and remove.

5. Thoroughly clean all foreign matter and coat the pipe surface with epoxy adhesive where the pipe joins the new structure.

6. Install a flexible joint sealer around the pipe.

7. Grout inside and outside of wall penetration with non-shrink grout.

L. Backfill structures in accordance with Section 31 00 01 – Earthwork.

M. Clean all structures of any accumulation of silt, debris, or foreign matter and keep clean until final acceptance of the work.

N. Excavation shall conform to Section 31 00 01 – Earthwork.

O. Structure bases shall bear on a minimum of 8-inches of compacted stone unless otherwise indicated on the Drawings.

P. Channel Inverts

1. Inverts shall be placed using Class B concrete with forms sufficient to provide a smooth half-round shape as shown on the Drawings. Manhole bases employing full depth precast inverts are acceptable.

2. Where the slope of the line does not change through a manhole, a constant slope shall be maintained in the invert. Where slope changes occur within a given manhole, the transition shall be smooth and shall occur at the approximate center of the manhole.

3. Inverts shown on the Drawings are taken at the center of the manhole unless otherwise noted.

3.05 ADJUSTMENTS TO EXISTING UTILITY STRUCTURES

A. Adjust structures as indicated on the Drawings using concrete or cast iron adjustment rings by approved methods.

B. Clean covers and inlet castings of all foreign material.

3.06 ADJUSTING COLLARS AND FINAL ADJUSTMENTS

A. Adjusting collars shall be as shown on the Drawings, or as necessary meet final grade. Final adjustments shall be made so that the manhole ring and cover will be smooth and flush with the finished grade of the adjacent surface, or as otherwise indicated on the Drawings for manholes shown above grade.

3.07 LEAKAGE TESTING FOR MANHOLES

A. All manholes shall be vacuum tested as specified below. Refer to Section 33 24 00 – Storm Drains and Roof Drains for storm water pipe testing.

B. Manhole vacuum testing shall include the following minimum requirements:

1. Testing shall be done in accordance with ASTM C1244 (latest revision).

2. Prior to testing all pipes, holes, and vents entering manhole shall be plugged and braced.

3. Contractor shall have an approved test head and copy of instructions for use by the manufacturer.

4. Contractor shall furnish two (2) certified and calibrated vacuum test gauges for the test.

    a. A vacuum of 10-inch hg shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time for the vacuum pressure to drop to 9-inch hg shall be measured. If the test time meets or exceeds the test time as specified in Table 1, the manhole is acceptable; otherwise, the test has failed and the manhole should be checked for leaks, repaired, and re-tested.

Table 1
Minimum Vacuum Test Times (Seconds) for Various Manhole Diameters and Depths

	Manholes Ø (inches)						
Depth (ft)	**48**	**60**	**72**	**84**	**96**	**108**	**120**
6’	15	20	25	29	34	38	43
8	20	26	33	38	45	51	57
10	25	33	41	48	56	63	71
12	30	39	49	57	67	76	85
14	35	46	57	67	78	89	100
16	40	52	67	76	89	101	114
18	45	59	73	86	100	114	128
20	50	65	81	95	111	126	142
22	55	72	89	105	122	139	156
24	59	78	97	114	133	152	170
26	64	85	105	124	144	164	185
28	69	91	113	133	155	177	199
30	74	98	121	143	166	189	213
Add. VF	+2.5	+3.25	+4.0	+4.75	+5.5	+6.5	+7.0

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SECTION 33 24 00
STORM DRAINS AND ROOF DRAINS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, equipment and materials in connection with the installation of exterior underground Storm drains and Roof drains as shown on the Contract Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 00 01 – Earthwork

B. Section 31 00 02 – Excavation

C. Section 33 05 039.23 – Reinforced Concrete Pipe

D. Section 33 06 61 – Utility Structures

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM C 76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

B. ASTM C 150 – Standard Specification for Portland Cement.

C. ASTM C 443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

D. ASTM C478 –Standard Specification for Precast Reinforced Concrete Manhole Sections

E. ASTM C857 – Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

F. ASTM C969 – Standard Practices for Infiltration and Exfiltration Testing of Installed Precast Concrete Pipe Sewer Lines

G. ASTM C990 – Standard Specification for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

H. ASTM C1103 – Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

I. ASTM C1619 – Standard Specifications for Elastomeric Seals for Joining Concrete Structures

J. ASTM C1628 – Standard Specifications for Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets

K. ASTM D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.

L. ASTM D 3350 – Standard Specifications for Polyethylene Plastic Pipe and Fitting Material.

M. AWWA C 110 – Standard Specification for Ductile Iron Pipe & Fittings for Water and Other Liquids.

N. AWWA C 151 – American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

O. AASHTO M 198 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

P. AASHTO M 294 – Standard Specifications for Corrugated Polyethylene Pipe (12” to 36”).

Q. AASHTO Section 30 – Thermoplastic Pipe.

1.04 SUBMITTALS

A. Furnish and submit shop drawings and certificates for the piping work as outlined in the General Conditions and Division 1.

B. Special care shall be exercised during delivery, distribution and storage of the pipe and fittings to prevent damage. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Storage of pipe and fittings, prior to use, shall be in such a manner as to keep the materials clean and dry.

PART 2 – PRODUCTS

2.01 REINFORCED CONCRETE PIPE (RCP) – STORM DRAINS AND CULVERTS

A. Pipe and Joints

1. Reinforced concrete pipe for storm drains and culverts shall conform to ASTM Standard C76, Class III, Wall thickness B, unless otherwise noted on the Contract Drawings. Elliptical reinforcement will not be permitted. All pipe shall be aged at

the manufacturing plant for at least fourteen (14) days before delivery to the job site. All pipe shall be of the sizes indicated on the drawings

2. Pipe joints shall be designed per ASTM C-443-19a and ASTM C-1628 –19. Pipe shall be provided with bell and spigot ends.

B. Gaskets

1. Gaskets shall be leak-resistant with elastomeric seals (gaskets) made of natural rubber, synthetic rubber, or a blend of both meeting the physical requirements prescribed in Specification ASTM 1619-19 for Class A, C, or E gaskets.

C. Joint Lubricant

1. Joint lubricant shall be of the type recommended by the manufacturer. Use of petroleum based lubricants is not permitted.

2.02 BACKFILL MATERIAL

A. The material obtained from excavation of the pipe trench or elsewhere on site with a particle size not greater than 2 inches shall be used for pipe backfill if they conform with the soil classes given in Table 1. Imported materials meeting the criteria of Table 1 may also be used. Backfill material within the limits of the embankment dam shall also include concrete and be in accordance with Details on Sheet C09 of the Contract Drawings.

Table 1: Acceptable Backfill Material and Compaction Requirements

Soil Classifications				
Description	**ASTM D 2321**	**ASTM D 2487**	**AASHTO M 43**	**Minimum Standard Proctor Density %**
Graded or crushed, crushed stone, gravel	Class I	--	5 56	Dumped
Well-graded sand, gravels and gravel/sand mixtures, poorly graded sand, gravels and gravel/sand mixtures; little or no fines	Class II	GW GP SW SP	57 6	95%
Silty or clayey gravels, gravel/sand/silt or gravel and clay mixtures; silty or clayey sands, sand/clay or sand/silt mixtures	Class III	GM GC SM SC	Gravel and Sand (<10% fines)	95%

PART 3 – EXECUTION

3.01 INSPECTION

A. Each length of pipe and fittings delivered to the property shall be inspected by the Contractor, in the presence of the Engineer, for flaws, cracks, dimensional tolerances and compliance with the referenced Standards. The Contractor shall provide the Engineer with suitable templates or calipers for checking pipe dimensions. Only lengths of pipe and fittings accepted by the Engineer and so marked may be installed in the work.

3.02 INSTALLATION

A. Trenching, bedding, and backfilling shall be as specified in Division 31 of these Specifications and Details on Sheet C09 of the Contract Drawings. Under no condition shall pipe be laid in water or when trench conditions or weather are unsuitable for such work.

B. All pipes and fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists or lowered on skidways in such a manner as to avoid shock. Derricks, ropes or other suitable equipment shall be used for lowering the pipe into the trench. Pipe and fittings shall not be dropped or dumped.

C. Each pipe and fitting shall be inspected before it is lowered into the trench. The interior of the pipe and all joint surfaces shall be thoroughly cleaned and shall thereafter be maintained clean. The open ends of pipe shall be securely plugged whenever pipe laying is not in progress.

D. Pipe and fittings shall be selected so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. All joints shall be installed, made up and inspected in accordance with approved printed instructions of the manufacturer. Pipe and fittings which do not fit together to form a tight joint will be rejected.

E. Cutting of reinforced concrete pipe will be permitted only at connections to structures and be accomplished by abrasive saws. Cutting of other pipe materials shall be done only with mechanical cutters and in accordance with the manufacturer's recommendations.

F. Pipe shall be laid accurately to the lines and grades shown on the drawings or as directed by the Engineer.

G. If an adequate foundation for the pipe is not available at the desired depth, additional excavation shall be required, and the foundation brought to desired grade with suitable granular material.

H. Rock outcroppings, very soft soils such as muck, and other similar materials not providing proper foundation support shall be removed/replaced with suitable granular material.

I. Bedding material directly under the pipe invert shall be left in native condition and not compacted. Pipe shall be placed on the bedding, then backfilled under the pipe haunches before further backfill is placed.

J. Class I materials may be dumped around pipe. Voids shall be eliminated by knifing under and around the pipe or by other approved technique.

K. Inorganic silts, and gravelly, sandy, or silty clays, and other Class IV materials (not shown in Table 1) shall not be used for pipe backfill.

L. Any section of the pipe that is found defective in material, alignment, grade, joints, or otherwise, shall be satisfactorily corrected by the Contractor at no additional cost to the Owner.

3.03 COMPACTION

A. General

1. Place and assure backfill and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.

2. In no case shall degree of compaction below “Minimum Compactions” specified be accepted.

B. Compaction Requirements: Unless noted otherwise on the Drawings or more stringently by other Sections of these Specifications, comply with following trench compaction criteria:

Table 2: Minimum Compactions

Location	Soil Type	Density
Compacted Select Backfill		
All applicable areas	Cohesive soil	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
Common Trench Backfill		
Under pavements roadways surfaces, D698 within highway rights-of-way, adjacent to retaining walls	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
Under turfed, sodded plant seeded, non-traffic areas	Cohesive soils	95 percent of maximum dry density by ASTM D698

Table 2: Minimum Compactions

Location	Soil Type	Density
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254

C. Ensure backfill materials have moisture content within three (3) percent of optimum moisture content at the time of placement.

3.04 INSPECTION AND TESTING

A. General

1. The Contractor shall provide at his own expense, all labor, material, video and measuring devices, water, plugs, or other equipment necessary to perform the required tests. All tests shall be performed in the presence of the Engineer. Disposal of water shall be through WTP's storm drain system; disposal shall be coordinated in advance with Owner.

B. Tests by Manufacturer

1. Reinforced Concrete Storm Drains and Culverts - An infiltration and exfiltration test for the pipe shall be made at the place of manufacture. Certified test results shall be submitted. The infiltration or exfiltration allowance shall not exceed the limits as set in the "Performance requirements for Joints" paragraph in ASTM C443 – 12 (2017) or ASTM C990-09 (2014), depending on the type of gasket specified.

2. DIP and HDPE - An infiltration and exfiltration test for the pipe shall be made at the place of manufacture. Certified test results shall be submitted. The infiltration or exfiltration allowance shall not exceed 250 gallons per inch of pipe diameter per mile per day. One joint test for each two hundred feet of pipe to be furnished.

C. Field Test - Visual Inspection

1. Examine structures and pipes for:

a. Physical damage.

b. Indication of displacement of pipes or structures, reinforcement, forms, or bedding.

c. Porous areas or voids.

d. Proper placement of seals, gaskets, and embedments.

e. Visible infiltration.

2. Verify structures and pipes are set to proper line, grade as per the Contract Drawings, and are plumb.

3. Verify structure and pipe dimensions and thickness match Contract Drawings.

4. Measure inside dimensions of all flexible (HDPE) pipe prior to installation. Use these dimensions when sizing the mandrel should deflection testing be required.

    a. Using light to inspect pipe shall be done following pipe trench backfill is compacted and brought to grade or pavement subgrade.

    b. Full pipe diameter shall be visible for entire length of each section between structures.

    c. No less than half pipe diameter shall be visible for horizontal alignment.

5. The Contractor shall be responsible to provide video recording of the all installed storm sewer systems at least 30 days after completion of backfill and one month before Owner or Engineer gives final acceptance for the two-year warranty. The recording shall be made using a color camera, self-propelled or other, having sufficient light to show detail of problem areas and joints. Camera speed shall not exceed 3 feet per second. If problems or concerns are seen by the operator, then the camera shall be reversed and an extended look at the area will be recorded. All recordings will have time, date, and footage displayed. Supplement the video recording with a written log or orally recorded tape log noting observations, findings, and deficiencies shown on the video tape.

    a. The video recording inspection shall be performed by an outside independent testing agency acceptable to the Owner or Engineer.

    b. The video tape and log will be given to the Engineer for review. If the Engineer finds any problems with the storm sewer, the Contractor will repair the problem and re-camera the repaired area before final acceptance will be given, at no added cost to the Owner.

    c. Video recording of storm sewer may be waived if pipe diameter is sufficient for human access, as determined by the Engineer. A log shall be developed for such inspection.

    d. One copy of the video tape and log will become permanent property of the Engineer and Owner as record.

D. Field Test - Manhole Testing

1. The finished manholes shall be as watertight as the pipe system of which it is part. See Section 33 05 61 – Utility Structures for manhole testing criteria.

2. Observed leaks (infiltration or exfiltration) at any time within the warranty period shall be cause for rejection.

E. Field Test - Storm Drains and Culverts less than 30” Ø

1. If, after the visual inspection and video recording of the storm trunk or lateral lines, the Engineer finds there is a potential joint tightness problem, or excessive deflection, and the Contractor does not agree to repairing defects in pipe based on visual inspection, the Engineer may require leakage testing of the line.

    a. Reference ASTM C696, latest revision. Test shall be used if the groundwater level is less than 2 ft. above the crown of the pipe measured from the highest elevation of the pipe length being tested.

    b. Leakage rate testing applies to only circular pipe less than 30” Ø. The length of pipe tested shall not exceed 700 ft.

    c. The leakage testing shall occur at least 30 days after completion of the backfilling and compaction.

    d. If the Engineer determines reliable and uniform results are produced by the Contractor's construction techniques, the leakage testing may occur after initial backfill and compaction.

2. The Contractor shall provide all equipment and personnel to perform the leakage testing.

3. The Engineer shall record times and calculation leakage rates during the test period.

4. The leakage test shall be performed as follows:

    a. Plug all pipe outlets discharging into the upstream manhole and the test section outlet. Fill the sewer line with water.

    b. At the upstream manhole the test head shall be established as minimum of 2 ft above the crown of the pipe, or at least 2 ft above existing groundwater, whichever is higher.

    c. Allow the pipe to remain saturated for a period long enough to allow water absorption in the pipe, a minimum of 4 hours and up to a maximum of 72 hours. After the absorption period, refill the pipe to the required test head.

    d. Measure the leakage loss over a timed test period. The minimum test period shall be 15 minutes and the maximum shall not exceed 24 hours.

5. The allowable leakage limit including manholes is 250 gal/(in. of internal diameter) (mile of sewer) (24 h) when the average head on the test section is 6 ft or less.

6. When the average head on the test section is greater than 6 ft, the allowable leakage shall be multiplied by the ratio of the square root of the average test head and the square root of the base head of 6 ft.

7. Manholes shall be tested separately and independently or with the pipeline with an allowance of 0.1 gal/(ft of diameter) (ft of head) (h).

8. Sections of the pipe which fail the air test, shall have the defects repaired, and the test shall be repeated.

    a. The initial leakage testing, repair, and repeat testing of the failed section of pipe shall be repeated at no added cost to the Owner until the testing requirements are met.

F. Deflection Test – Flexible Pipe

1. If after the visual or video inspection of the storm trunk or lateral lines, the Inspector finds there is “egging or deflection” of a section of pipe, a deflection test shall be performed on the defective section of pipe installed. Test shall be performed using an odd-legged mandrel pulled through the pipe without mechanical assistance or by laser profiling. The mandrel size shall be the measured inside diameter of the subject pipe minus 5% of the measured diameter. The mandrel shall have no less than nine legs.

2. Any pipe failing any deflection test shall be removed, replaced, and retested.

3. At the end of the two-year warranty period, the flexible storm pipe will be visually inspected for “egging or deflection”. If excess deflection is observed, the Owner/Warranty Holder will, at his/her expense, retest questionable portions per this section.

G. Repair

1. Repair or replace any unacceptable work at no additional cost to the Owner.

2. Repair all visible leaks.

3. Remove any concrete webs or protrusions.

4. Remove form ties and repair tie holes.

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SECTION 33 71 19
UNDERGROUND ELECTRICAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install underground duct systems and electric handholes as specified herein and as indicated on the Drawings. The work shall be complete and shall include excavation, concrete construction, backfilling, and all materials, items, and components required for a complete system.

B. The provisions of this Section are applicable to all underground conduit work. All work shall be coordinated with that of the various utility companies and other Contractors. The Contractor shall adhere to all utility company requirements including the serving electric utility.

C. Reference Section 26 05 00 – Basic Electrical Requirements; Section 26 05 33.13 – Conduit for Electrical Systems; Section 26 05 26 – Grounding and Bonding for Electrical Systems; the applicable sections of Division 31, Earthwork; Section 03 21 00 – Reinforcing Steel; and 03 30 00 – Cast-In-Place Concrete.

1.02 CODES AND STANDARDS

A. Products specified herein shall be designed, manufactured, and/or listed to the following standards as applicable:

1. AASHTO H20

2. ANSI/SCTE 77-2010 – Specification for Underground Enclosure Integrity

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit Shop Drawings. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to, the following:

1. Product data sheets.

2. Outline and dimensional drawings including detailed sections of the handholes.

1.05 IDENTIFICATION

A. Each electric handhole cover shall be lettered with the word “Electric”, the handhole identification number (e.g. EHH-1, CHH-1, etc.), manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings.

2.02 DUCT SYSTEM

A. The underground duct system shall be comprised of conduits, conduit bends, and conduit fittings as specified in Section 26 05 33.13 – Conduit for Electrical Systems. Conduits shall be encased in reinforced concrete envelopes, unless otherwise specified herein or indicated on the Drawings.

B. Base and intermediate conduit spacers shall be furnished to provide a minimum of two-inch (2”) separation between conduits. Conduit spacers shall be provided in the proper size as required for the conduit that they secure. For example, a 4” conduit spacer shall not be used to secure a 2” conduit. Conduit spacers shall be as manufactured by Carlon Electrical Products Company, Aeroquip Corporation, Underground Devices, Incorporated, or equal.

2.03 ELECTRIC HANDHOLES

A. The electric handholes shall be a precast polymer concrete enclosure suitable for use as part of an underground electric raceway system. The enclosure shall meet or exceed the requirements of ANSI/SCTE 77-2010.

B. The enclosure and cover design and test load rating shall be Tier 15. Covers shall be provided with cover hooks.

C. The enclosure shall be the straight side design to allow easy adjustment of box to grade. The box shall be stackable for increased depth.

D. Handhole opening size shall be as required to suit the application, 6” X 8”, minimum.

E. The electric handholes shall be manufactured by Hubbell, Pencell Plastics equivalent, Highline Products equivalent, or equal.

PART 3 – EXECUTION

3.01 GENERAL

A. The underground duct system and handholes shall be installed as specified herein, indicated on the Drawings, and in accordance with manufacturers’ instructions.

3.02 DUCT SYSTEM

A. All underground conduit shall be encased in concrete and shall be reinforced. Encasement and reinforcement shall be as indicated in the standard details. Concrete shall be furnished and installed in accordance with Section 03 30 00 – Cast-In-Place Concrete. Reinforcing steel shall be furnished and installed in accordance with Section 03 21 00 – Reinforcing Steel.

B. Concrete pours shall be complete from handhole to handhole where practicable. Partial pours in general shall not be permitted. Where a complete pour is impractical, written authorization shall be obtained from the Engineer for the partial pour.

C. Conduit ductbank elevations at the handholes shall be based on minimum ductbank cover as indicated in the standard details, or deeper to avoid conflicts with other obstacles. Where deviation is necessary to clear unforeseen obstacles, the elevations may be changed after authorization by the Engineer.

D. Slope all conduits continuously away from structures and buildings with a minimum slope of 3” per 100’ unless otherwise indicated on the Drawings.

E. The minimum clearance from the top of the concrete encasement and finished grade shall be as indicated in the standard details, except where otherwise accepted in writing by the Engineer or shown on the Drawings.

F. Care shall be exercised during excavation for the duct banks to prevent digging too deep. Backfilling of low spots with earth fill will not be permitted unless thoroughly compacted and acceptable to the Engineer.

G. If a specific ductbank arrangement is shown on the Drawings, the conduits in that ductbank shall be arranged as shown. Where no specific ductbank arrangement is shown on the Drawings, the Contractor shall arrange conduits within each ductbank based on field conditions. Spare conduits shown going from ductbanks into buildings or structures shall be stubbed up in the location(s) as indicated on the Drawings.

H. A minimum of one (1) ground rod, furnished in accordance with Section 26 05 26 – Grounding and Bonding for Electrical Systems, shall be driven adjacent to each handhole or other concrete box. A No. 4/0 AWG bare copper ground cable shall be connected between this rod and the copper ground strap using a silicon bronze connector. All ground rods shall be interconnected by means of the No. 4/0 AWG bare copper ground cable located within each duct bank. The ends of these cables shall also be connected to substation and/or building ground buses where the conduits terminate.

I. Care shall be exercised and temporary plugs shall be installed during installation to prevent the entrance of concrete, mortar, or other foreign matter into the conduit system. Conduit spacers shall be utilized to support conduit during the pouring of concrete to prevent movement and misalignment of the conduits. Conduit spacers shall be installed in accordance with manufacturer's instructions unless otherwise noted. Horizontal spacing of conduit spacers along ductbank shall be as indicated on the Standard Details.

J. Where connections to existing underground conduits are indicated, excavate to the maximum depth necessary. After addressing the existing conductors, cut the conduits and remove loose concrete from the conduits before installing new concrete encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines.

K. Six (6) inches above all duct banks, the Contractor shall furnish and install a two (2) inch wide red plastic electrical hazard tape. Tapes shall be metallic detectable type and shall have a continuous message in bold black letters: "ELECTRIC LINE BURIED BELOW." Tape shall be Detectable Identoline by Brady, or equal.

L. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, shoring and bracing, grading and restoration of surfaces and seeded areas disturbed during the execution of the work.

M. All conduit joints in the duct system shall be staggered such that adjacent conduits do not have joints in the same location.

3.03 ELECTRIC HANDHOLES

A. Electric handholes shall be installed to a sufficient depth to accommodate the required grading of ducts as well as maintaining a minimum distance of 9" from the bottom of the lowest duct centerline entrances to finished floor line and/or highest duct centerline entrance to roof. All handholes shall be built on or placed over a 6" layer of well-tamped gravel.

B. Duct envelopes and conduit with bell ends shall enter at approximately right angles to the walls, except as may otherwise be shown on the Drawings.

C. All fully assembled handholes shall be completely watertight.

D. All individual cables and/or bundles of conductors shall be identified and “dressed” along the wall of the enclosure. Cable racks as specified herein shall be provided if any handhole dimension exceeds 24 inches.

3.04 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Field tests

a. Field tests for all completed duct systems shall consist of pulling a swab through each conduit followed by a mandrel equal in size to 85% of the conduit inside diameter.

b. After testing, all conduits shall be capped after installation of a suitable pull rope. All field tests shall be witnessed by the Engineer.

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SECTION 40 05 00
BASIC MECHANICAL REQUIREMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. Piping to be backfilled and/or encased in concrete is considered to be buried piping. Piping that is not buried is considered to be exposed.

B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section and other concurrent Contracts for a complete installation.

C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, wall sleeves, wall pipes, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.

D. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.

E. The work shall include, but not be limited to, the following:

1. Connections to existing pipelines.

2. Test excavations necessary to locate or verify existing pipe and appurtenances.

3. Installation of all new pipe and materials required for a complete installation.

4. Cleaning, testing and disinfecting as required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01 – General Requirements

B. Division 02 – Existing Conditions

C. Division 05 – Metals

D. Division 09 – Finishes

E. Division 26 – Electrical

F. Division 46 – Water and Wastewater Equipment

1.03 MATERIAL CERTIFICATION AND SHOP DRAWINGS

A. The Contractor shall furnish to the Owner (through the Engineer) a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.

B. Shop Drawings shall be prepared and submitted in accordance with Section 01 33 00 – Submittal Procedures. In addition to the requirements of Section 01 33 00 – Submittal Procedures, the Contractor shall submit laying schedules and detailed Drawings in plan and profile for all piping as specified and shown on the Drawings.

C. Shop Drawings shall include, but not be limited to, complete piping layout, pipe material, sizes, class, locations, necessary dimensions, elevations, supports, hanger details, pipe joints, and the details of fittings including methods of joint restraint. No fabrication or installation shall begin until Shop Drawings are approved by the Engineer.

PART 2 – PRODUCTS

2.01 GENERAL

A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.

B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in Part 3.

C. Joints in piping shall be of the type as specified in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

D. All buried piping shall have restrained joints for thrust protection unless otherwise specified or shown on the Drawings. All exposed piping shall have flanged joints, unless otherwise specified or shown on the Drawings.

E. The Drawings indicate work affecting existing piping and appurtenances. The Contractor shall excavate test pits as required of all connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

2.02 SLEEVES

A. Unless shown otherwise, all piping passing through walls and floors shall be installed in sleeves or wall castings accurately located before concrete is poured or placed in position during construction of masonry walls. Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise. Water stop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall.

B. Sleeves shall be cast iron, black steel pipe, or fabricated steel in accordance with details shown on the Drawings. If not shown on the Drawings, the Contractor shall submit to the Engineer the details of sleeves he proposes to install; and no fabrication or installation thereof shall take place until the Engineer's approval is obtained. Steel sleeves shall be fabricated of structural steel plate in accordance with the standards and procedures of AISC and AWS. Steel sleeve surfaces shall receive a commercial sandblast cleaning and then be shop painted in accordance with Section 09 90 00 – Painting.

C. When shown on the Drawings or otherwise required, the annular space between the installed piping and sleeve shall be completely sealed against a maximum hydrostatic pressure of 20 psig. Seals shall be mechanically interlocked, solid rubber links, trade name "Link-Seal", as manufactured by Garlock Pipeline Technologies (GPT) or equal. Rubber link, seal-type, size, and installation thereof, shall be in strict accordance with the manufacturer's recommendations. For non-fire rated walls and floors, pressure plate shall be glass reinforced nylon plastic with EPDM rubber seal and 316 stainless steel bolts and nuts. For fire rated walls and floors, two independent seals shall be provided consisting of low carbon steel, zinc galvanized pressure plates, silicon rubber seals and 316 stainless steel bolts and nuts.

D. Cast iron mechanical joint adapter sleeves shall be Clow # 1429, as manufactured by the Clow Corp., or equal. Mechanical joint adapter sleeves shall be provided with suitable gasket, follower ring, and bolts to affect a proper seal. In general, sleeves installed in walls, floors, or roofs against one side of which will develop a hydrostatic pressure, or through which leakage of liquid will occur, shall be so sealed. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange.

2.03 SOLID SLEEVE COUPLINGS (FOR BURIED SERVICE THROUGH 54-INCH)

A. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the

requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal. Solid sleeve couplings shall be restrained with wedge-type restraining glands to meet the pressures specified in 40 06 20 – Schedules.

B. Alternatively, EBAA Iron 3800 Mega-Coupling is acceptable.

2.04 DISMANTLING JOINTS

A. Dismantling joints shall be furnished at locations shown on the Drawings.

B. Dismantling joints for sizes less than 12-inch shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping. Dismantling joints for sizes greater than 12-inches shall be of carbon steel construction and shall be rated for the same pressure as the connected piping.

C. Flanges for dismantling joints shall match the bolt pattern and pressure rating of the flanges for the connected piping.

D. All dismantling joints shall be restrained utilizing restraining rods provided by the manufacturer. Restraining rods shall be constructed from ASTM A193 Grade B7 steel. Restraining rods and restraint system shall be installed in strict accordance with manufacturer's recommendations.

E. Dismantling joints shall be provided with manufacturer's fusion bonded epoxy painting system.

F. Dismantling joints shall be manufactured by Smith Blair Model 975, Romac Industries Model DJ400, or equal.

2.05 FLEXIBLE RESTRAINED EXPANSION JOINTS

A. Restrained expansion joints shall be manufactured of 60-42-10 ductile iron conforming to material and other applicable requirements of ANSI/AWWA C153/A21.53.

B. Each pressure containing component shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the materials requirements of, and tested in accordance with, ANSI/AWWA C213 and shall meet or exceed the requirements of ANSI/AWWA C550.

C. Seals shall conform to the applicable requirements of ANSI/AWWA C111/A21.11.

D. All bolts used in the assemblies shall be stainless steel and shall be coated with a premium quality epoxy.

E. Flanged ends shall comply with ANSI/AWWA C110/A21.10, with the addition of O-ring groove and O-ring.

F. Mechanical joint ends shall comply with ANSI/AWWA C153/A21.53.

G. Restrained expansion joints shall have a minimum pressure rating of 350 psi with a minimum safety factor of 3:1. Each assembly shall be tested at 350 psi before shipment.

H. Restrained expansion joints shall provide for self-restraint without tie rods and shall provide for expansion and contraction capabilities cast as an integral part of the end connection.

I. Flexible restrained expansion joints shall allow for 8-inches (+6"-2") minimum expansion.

J. Flexible restrained expansion joints shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint having a minimum of 15□ deflection per ball.

K. Restrained expansion joints shall be the Single Ball or Double Ball FLEX-TEND Expansion Joint as manufactured by EBAA Iron Inc., or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work. All piping connections to equipment shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment. At certain applications, Dresser, Victaulic, or equal, couplings may also be used. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Unless otherwise shown or approved, provided a minimum headroom clearance under all piping of 7 feet 6 inches.

B. Unless otherwise shown or specified, all waste and vent piping shall pitch uniformly at a 1/4-inch per foot grade and accessible cleanouts shall be furnished and installed as

shown and as required by local building codes. Installed length of waste and vent piping shall be determined from field measurements in lieu of the Drawings.

C. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.

D. ALL EXCAVATION REQUIRED BY THIS CONTRACT SHALL BE UNCLASSIFIED. NO ADDITIONAL PAYMENT WILL BE MADE FOR ROCK EXCAVATION REQUIRED FOR THE INSTALLATION OF PIPE OR STRUCTURES SHOWN ON THE DRAWINGS.

E. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.

F. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.

G. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately one hundred (100) feet. The Contractor shall excavate the trenches to the full depth, width and grade indicated on the Drawings including the relevant requirements for bedding. The trench bottoms shall then be examined by the Engineer as to the condition and bearing value before any pipe is laid or bedding is placed.

H. No pressure testing shall be performed until the pipe has been properly backfilled in place. All pipe passing through walls and/or floors shall be provided with wall pipes or sleeves in accordance with the specifications and the details shown on the Drawings. All wall pipes shall be of ductile iron and shall have a water stop located in the center of the wall. Each wall pipe shall be of the same class, thickness, and interior coating as the piping to which it is joined. All buried wall pipes shall have a coal tar outside coating on exposed surfaces.

I. JOINT DEFLECTION SHALL NOT EXCEED 75 PERCENT OF THE MANUFACTURER'S RECOMMENDED DEFLECTION. Excavation and backfilling shall conform to the requirements of Section 31 00 01 – Earthwork, and as specified herein. Maximum trench widths shall conform to the Trench Width Excavation Limits shown on the Drawings. All exposed, submerged, and buried piping shall be adequately supported and braced by means of hangers, concrete piers, pipe supports, or otherwise as may be required by the location.

J. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. UNDER NO CIRCUMSTANCES SHALL ANY OF THE MATERIALS BE DROPPED OR DUMPED INTO THE TRENCH.

K. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.

L. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Pipes crossing within a vertical distance of less than or equal to one (1) foot shall be encased and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.

M. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at his own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.

N. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.

O. AT THE CLOSE OF EACH WORK DAY, THE END OF THE PIPELINE SHALL BE TIGHTLY SEALED WITH A CAP OR PLUG SO THAT NO WATER, DIRT, OR OTHER FOREIGN SUBSTANCE MAY ENTER THE PIPELINE, AND THIS PLUG SHALL BE KEPT IN PLACE UNTIL PIPE LAYING IS RESUMED.

P. During the laying of pipe, each pipe manufacturer shall provide his own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed.

Q. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used exceptions: closure pieces at manholes and areas where joint deflection is required.

R. For gravity sewer installations, the Contractor shall use a laser device to maintain the trench and pipe alignment. The laser device shall be re-checked for correct elevation and pipe alignment prior to pipe installation if the device is left in the pipe overnight.

Corrected invert elevations at each manhole and any adjustments will be coordinated and approved by the Engineer.

S. ALL PIPING SHALL HAVE EITHER “TYPE B" BEDDING OR “PIPE BEDDING INSIDE LIMITS OF DAM” AS SHOWN ON THE DRAWINGS, UNLESS OTHERWISE SPECIFIED HEREIN OR INDICATED ON THE DRAWINGS.

3.02 JOINTS IN PIPING

A. Restrained joints shall be provided on all pipe joints as specified herein and shown on the Drawings.

B. Mechanical joints shall be made up with gaskets, glands and bolts. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution of mild soap in water; the gland and gasket shall be slid onto the plain end and the end then entered into the socket until it is fully "home" on the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened alternately to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to assure that the pipe remains fully "home" while the joint is being made. Joints shall conform to the applicable AWWA Specifications.

3.03 FLUSHING AND TESTING

A. All piping shall be properly flushed and tested unless specifically exempted elsewhere in the Specifications or otherwise approved by the Engineer. Gravity sewer piping shall be flushed and tested as specified in Section 33 05 61 – Utility Structures. All other liquid conveying pipelines shall be flushed and tested with water. The Contractor shall furnish and install all means and apparatus necessary for getting the air or water into the pipeline for flushing and testing including pumps, compressors, gauges, and meters, any necessary plugs and caps, and any required blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. All pipelines shall be flushed and tested in such lengths or sections as agreed upon among the Owner, Engineer, and Contractor. Test pressures shall be as specified in Section 40 06 20 – Process Pipe, Valve and Gate Schedules and shall be measured at the lowest point of the pipe segment being tested. The Contractor shall give the Owner and Engineer reasonable notice of the time when he intends to test portions of the pipelines. The Engineer reserves the right, within reason, to request flushing and testing of any section or portion of a pipeline.

B. The Contractor shall provide water for all flushing and testing of liquid conveying pipelines. Raw water or non-potable water may be used for flushing and testing liquid pipelines not connected to the potable water system. Only potable water shall be used for flushing and testing the potable water system.

C. At the conclusion of the installation work, the Contractor shall thoroughly clean all new liquid conveying pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered the pipe during the construction period. If after this cleaning any obstructions remain, they shall be corrected by the Contractor, at his own expense, to the satisfaction of the Engineer. Liquid conveying pipelines shall be flushed at the rate of at least 2.5 feet per second for a duration suitable to the Engineer or shall be flushed by other methods approved by the Engineer.

D. During testing the piping shall show no leakage. Any leaks or defective piping disclosed by the leakage test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

E. After flushing, all liquid conveying pipelines shall be hydrostatically tested at the test pressure specified in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve and Gate Schedules. The procedure used for the hydrostatic test shall be in accordance with the requirements of AWWA C600. Each pipeline shall be filled with water for a period of no less than 24 hours and then subjected to the specified test pressure for 2 hours. During this test, exposed piping shall show no leakage. Allowable leakage in buried piping shall be in accordance with AWWA C600.

F. Any leaks or defective pipe disclosed by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

3.04 DISINFECTION

A. All pipe and fitting connected to and forming a part of a potable water supply shall be disinfected in accordance with the procedures described in AWWA C 651. Disinfection shall also be in accordance with the requirements of the Owner.

B. Disinfection shall be accomplished after the pipe has been flushed, if applicable, and passed the hydrostatic test. Such piping shall be filled with 50 parts per million (PPM) of chlorine and held in contact for not less than 24 hours. Final tests after 24 hours contact time shall show a minimum residual chlorine content of 10 ppm in all parts of the system. Disinfection shall be repeated as often as necessary, and as directed by the Engineer and/or the Owner until the minimum residual chlorine content of 10 ppm has been reached. The Contractor shall obtain certificates of satisfactory bacteriological tests and furnish them to the Owner before the request is made for acceptance of the work. The Contractor shall furnish and install, at his own expense, all means and apparatus necessary for performing the disinfection. The chlorine solution shall be thoroughly flushed out prior to placing the new sections of pipe in service. The Contractor is cautioned that the spent chlorine solution must be disposed of in such a way as not to be detrimental to animal, plant, or fish life. Chlorine residual tests will be made after flushing to assure that residual is not in excess of 1 ppm at any point in system.

3.05 PAINTING AND COLOR-CODING SYSTEM

A. All exposed piping specified shall be color coded in accordance with the Owner's standard color designation system for pipe recognition. In the absence of a standard color designation system, the Engineer will establish a standard color designation for each piping service category from color charts submitted by the Contractor in compliance with Section 09 90 00 – Painting.

B. All piping specified in this Section shall be painted in accordance with Section 09 90 00 – Painting.

END OF SECTION

SECTION 40 05 19
DUCTILE IRON PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. All ductile iron pipe and specials shall be marked with the manufacturer's name or trademark, size, weight, thickness class, the date of manufacture, and the word "Ductile".

B. Ductile iron pipe (DIP) of the sizes shown or specified shall conform to ANSI A21.51 (AWWA C151), Grade 60-42-10 for ductile iron pipe centrifugally cast in metal molds or sand-lined molds. All ductile iron pipe shall conform to ANSI A21.50 (AWWA C150) for thickness design and shall be supplied in 18 or 20 foot nominal lengths or as required to meet the requirements of the Drawings. Fittings and specials shall be cast iron or ductile iron, conforming to the requirements of ANSI A21.10 (AWWA C110) or ANSI A21.53 (AWWA C153).

C. Minimum Class 53 pipe shall be used for flanged spools.

D. Reference Section 40 05 00 – Basic Mechanical Requirements

E. Reference Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, for pressure rating requirements for specific applications.

F. Cobb County-Marietta Water Authority accepted ductile iron pipe manufacturers:

1. American ACIPCO
2. US Pipe
3. McWane
4. No other approved manufacturers

PART 2 – PRODUCT

2.01 DUCTILE IRON PIPE AND FITTINGS

A. All pipe and fittings, with the exception of glass lined pipe and sleeves, shall be cement mortar lined. Linings shall conform to American Standard Specifications for Cement Mortar Lining for Cast Iron Pipe and Ductile Iron Pipe and Fittings, ANSI A21.4 (AWWA C104) and shall be standard thickness. The mortar lining shall be protected with the bituminous seal coat. All buried DIP and fittings shall have a bituminous coating on the exterior surfaces in accordance with ANSI A21.51 (AWWA C151). All exposed DIP and

fittings shall have a shop applied prime coat in accordance with Section 09 90 00 – Painting.

B. Requirements for various types of joints are described in the following paragraphs. UNLESS OTHERWISE NOTED HEREIN OR ON THE DRAWINGS, ALL EXPOSED DUCTILE IRON PIPING SHALL HAVE FLANGED JOINTS.

C. Flanged joints and fittings shall have a minimum pressure rating of 250 psi with 125 lb. American Standard flanges. All flanges and fittings shall conform to the requirements of ANSI B16.1. Flanges shall be ductile iron and shall be of the threaded or screw on type. The face of the flanges shall be machined after installation of the flange to the pipe. No raised surface shall be allowed on flanges. Flanged pipe shall conform to the requirements of ANSI Specification A21.15, (AWWA C115). Pipe lengths shall be fabricated to meet the requirements of the Drawings.

D. Gaskets shall be the "Ring Gasket" type, 1/8-inch minimum thickness, cloth inserted rubber, red rubber or neoprene and shall be suitable for the service intended. Gaskets for glass lined pipe shall be TORUSEAL flange gasket, or equal. Bolts shall be of the size and length called for and in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. The bolts for flanged joints shall be a minimum ASTM A307; Grade B carbon steel and be in accordance with ANSI A21.10, (AWWA C110). The bolts shall have hexagonal heads and nuts, no washers shall be used.

E. Bell and spigot pipe shall be provided with push on, O-ring rubber gasket, compression type joints and shall conform to the requirements of ANSI A21.11 (AWWA C111). Fittings and specials shall be supplied with mechanical joints as specified for mechanical joint pipe. If required by installation conditions, pipe shall have cast-on lugs for adequately tying it together.

F. Mechanical joints and fittings shall conform to the requirements of ANSI A21.11, (AWWA C111). Joints shall be made employing a tapered rubber gasket forced into a tapered groove with a ductile iron follower ring. If required by installation conditions, pipe and fittings shall have cast-on lugs for adequately tying the pipe and fittings together. These shall be in conformance with standard practice and as outlined under the appropriate AWWA Specifications.

G. Bolts for mechanical joints shall be high strength corrosion resistant low-alloy steel tee-head bolts with hexagonal nuts.

H. Mechanical coupling joint pipe and fittings shall be split type, shouldered end. Coupling materials shall be malleable iron. Couplings shall have a minimum pressure rating and service equal to that of the connected piping. Gaskets shall be of rubber. Bolts and nuts shall be heat treated carbon steel track bolts and shall be plated. After installation, buried couplings shall receive two heavy coats of coal tar epoxy (min. 24 mil thickness) which is compatible with the finish of the couplings. Couplings shall be as manufactured by Victaulic Company of America Style 31, or equal.

I. Restrained joint pipe shall consist of factory manufactured bolted retainer rings, ductile iron locking segments held in place by rubber retainers, or ductile iron retaining rings that lock over the bell of the joint and are secured to prevent rotation, and factory welded retainer beads or rings on the spigot of the pipe. All components of the bolted or snap ring assemblies shall be constructed of corrosion-resistant, high strength, low-alloy steel. Restrained joint pipe shall be Flex-Ring or Lock-Ring type joints as manufactured by American Cast Iron Pipe Company, HP LOK or TR Flex as manufactured by US Pipe, Bolt-Lok or Snap-Lok as manufactured by Griffin Pipe Products, TR Flex or Super Lock as manufactured by Clow Water Systems Co., or approved equal.

J. Restrained fittings for piping systems 16-inches in diameter and greater shall have factory restraint systems identical to the factory restrained joint pipe specified in Item I above. All fittings shall be minimum pressure Class 250 unless otherwise specified.

K. Restrained fittings for pipe systems 14-inches in diameter and smaller shall be Mechanical Joint fittings with restraint assemblies such as Stargrip by Star Pipe Systems, Mega Lug by EBAA Iron, ONE LOK by Sigma, Grip Ring by Romac, or approved equal. Where threaded-rods are allowed, the rods and tabs shall be designed for the specified restraint system design pressure, shall have lengths less than 10 feet between fittings, and shall be painted with two heavy coats of coal tar epoxy after installation.

L. Installation of solid sleeves:

1. Spacer rings must be used with all solid sleeves and no exceptions will be allowed.

2. When connecting to existing water mains, one full length joint of pipe must be installed between solid sleeves and (DIP-PCCP) adaptor pieces.

M. The manufactured systems for thrust restraint indicated above shall be used where restrained joint ductile iron pipe and fittings are specified or indicated on the drawings. Gripping gaskets are not an acceptable form of restraint. Thrust restraint and harnessing systems such as threaded-rods, friction clamps, retainer glands shall be used only where specifically specified herein, indicated on the drawings or if allowed by the Engineer in isolated applications where conditions warrant and necessitate their use. Concrete thrust blocks may be used in accordance with the schedule indicated on the drawings, if applicable.

END OF SECTION

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SECTION 40 05 51
VALVES, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install, complete with all assemblies and accessories, all valves shown on the Drawings and specified herein including all fittings, appurtenances and transition pieces required for a complete and operable installation.

B. All valves shall be constructed of first quality materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual valves are designated. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications. Cast iron valve bodies and parts shall meet the requirements of the latest revision of ASTM Designation A-126, "Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B."

C. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.

D. Valves shall have flanged ends for exposed service and mechanical joint ends for buried service, unless otherwise shown on the Drawings or specified herein. Flanged ends shall be flat-faced, 125 lb. American Standard unless otherwise shown or specified in accordance with ANSI B16.1. All bolt heads and nuts shall be hexagonal of American Standard size. The Contractor shall be responsible for coordinating connecting piping. Valves with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves.

1.02 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Performance tests shall be conducted in accordance with the latest revision of AWWA C500.

2. Shop Drawings conforming to the requirements of Section 01 33 00 – Submittal Procedures, are required for all valves, and accessories. Submittals shall include all layout dimensions, size and materials of construction for all components, information on support and anchoring where necessary, pneumatic and hydraulic characteristics and complete descriptive information to demonstrate full compliance with the Documents. Shop Drawings for electrically operated/controlled valves shall include all details, notes, and diagrams which

clearly identify required coordination with the electrical power supply and remote status and alarm indicating devices. Electrical control schematic diagrams shall be submitted with the Shop Drawings for all electrical controls. Diagrams shall be drawn using a ladder-type format in accordance with JIC standards. Shop Drawings for pneumatically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the compressed air (service air) system and electrical controls.

3. Operation and maintenance manuals and installation instructions shall be submitted for all valves and accessories in accordance with the Specifications. The manufacturer(s) shall delete all information which does not apply to the equipment being furnished.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall provide the services of a qualified representative of the manufacturer(s) of the equipment named below to check out and certify the installation(s), to supervise the initial operation, and to instruct the Owner's operating personnel in proper operation and maintenance procedures in accordance with the following schedule:

Item	Valve/Operator Type	Minimum On-Site Time Requirements
1	All Valves	One (1) 8-hour day

B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.

C. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies notes.

D. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

PART 2 – PRODUCTS

2.01 VALVE BOXES

A. The Contractor shall furnish and install valve boxes as shown on the Drawings and specified herein.

B. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The ground in the trench upon which the valve boxes rest shall be thoroughly compacted to prevent settlement. The boxes shall be fitted together securely and set so that the cover is flush with the finished grade of the adjacent surface. A concrete pad as detailed on the Drawings shall be provided around the valve box, sloped outwards.

C. All valve boxes shall be 2-piece cast iron, sliding type, 5-1/4" shaft, with heavy duty traffic weight collar and the lid marked with the appropriate carrier product (i.e.: WATER). Boxes shall be as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Charlotte Pipe and Foundry Company, or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Except where noted otherwise herein, all valves shall be installed and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under the Piping Specifications. The valves shall be so located that they are easily accessible for operating purposes and shall bear no stresses due to loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.

B. All valves shall be tested at the operating pressures at which the particular line will be used. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight. All motor operated and cylinder operated valves shall be tested for control operation as directed by the Engineer.

C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.

D. Install all valves and appurtenances in accordance with manufacturer's instructions. Install suitable corporation stops at all points shown or required where air binding of pipe lines might occur. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer. Unless otherwise approved, install all valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.

E. Valve boxes shall be set plumb and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

3.02 SHOP AND FIELD TESTING

A. Shop and field testing of valves shall be as follows:

1. Certified factory testing shall be provided for all components of the valve and operator system. Valves and operators shall be shop tested in accordance with the requirements in the latest revision of AWWA C500, including performance tests, leakage test, hydrostatic tests, and proof-of-design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.

2. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Any deficiencies found in shop testing shall be corrected prior to shipment. The system supplier through the Contractor shall submit written certification that shop tests for the electrical/pneumatic system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.

3. The Contractor shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Preliminary field tests shall be conducted prior to start-up with final field tests conducted during start-up. The factory service representative shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. The service representative shall certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.

4. Preliminary and final field tests shall be conducted at a time approved by the Engineer. The Engineer shall witness all field testing.

5. All costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

6. Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components. Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.

7. Final field acceptance tests shall be conducted simultaneously with the start-up and field testing of the pumps, air compressors, process air blowers, etc. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures shall be checked.

8. Field testing shall include optimization of opening and closing times of the valves. The Contractor shall provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

END OF SECTION

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SECTION 40 05 57
VALVE OPERATORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 40 05 00 – Basic Mechanical Requirements.

B. Reference Section 40 06 20 – Process Pipe, Valve, and Gate Schedules for additional information on valves and operators.

C. Valve operators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.

D. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer.

E. The valve operators shall be the full and undivided responsibility of the valve manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

1.02 SUBMITTALS

A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:

1. Shop Drawings

2. O&M Manuals

3. Certification that the force required to operate all valves is as specified herein.

PART 2 – PRODUCTS

2.01 GENERAL

A. Electric actuators shall be provided where specified in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

B. Manual operators shall be provided on all valves. Manual operator type shall be as specified herein and as shown on the Drawings.

C. Quarter turn valves 8” and greater in size shall have geared operators. Gate valves 14” and greater in size shall have geared operators.

D. Operators/actuators shall be furnished with conservatively sized extension bonnets, extension stems, or torque tubes, and all required appurtenances required for a complete installation. Operators furnished with extension bonnets shall include stainless steel extension stems, or stainless steel torque tubes.

2.02 MANUAL OPERATORS

A. Unless otherwise specified or shown on the Drawings, manual operator type shall be as follows:

1. Buried valves shall be equipped with nut operators, extended stems, and valve boxes. Where the depth of the operating nut is more than 4 feet below finish grade, a valve operator extension shall be provided to bring the operating nut to within 18-24 inches of the surface.

2. Exposed valves up to 6-inch shall be lever operated (except gate valves).

3. Exposed valves 8-inches and larger shall be handwheel operated.

4. Exposed gate valves shall be handwheel operated.

5. Valves with centerline of operator located more than 6-feet above the floor or platform from which it is to be operated shall have a chainwheel operator unless otherwise indicated on the Drawings.

B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.

C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.

D. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain (including breakaway torque requirements) does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Design pressures for sizing of valve operators shall be the piping test pressure for the piping in which the valve is to be installed as shown in the Piping Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

E. Handwheels for valves operators shall not be less than 12 inches in diameter. The maximum diameter of any handwheel shall not exceed 24”.

F. Nut operators shall have standard 2-inch square AWWA operating nuts designed in accordance with AWWA C504-94.

G. Geared manual operators shall be of the worm gear, traveling nut or scotch yolk type except manual operators for butterfly valves 18-inch in diameter or larger which shall be worm gear, unless otherwise indicated in the individual valve specification. Gear operators shall be of the worm gear or bevel gear type. Gear box designs incorporating end of travel stops in the housing shall be equipped with AWWA input stops. Each gearbox shall require a minimum of 10 turns for 90 degree rotation or full valve stem travel and shall be equipped with a mechanical valve position indicator.

H. Manual operators on below grade (and vault installed) valves shall be permanently lubricated and watertight under an external water pressure of 10 psi.

2.03 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following:

1. One (1) T-handle gate valve key (6-foot)

2. One (1) valve wheel wrench

PART 3 – EXECUTION

3.01 INSTALLATION

A. All valve actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable Specification Sections for valves and motor controls.

B. Valve actuators shall be factory coated in accordance with the manufacturer’s standard paint system.

3.02 FIELD TESTS

A. Field testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:

1. Valve operators shall be field-tested together with the associated valves.

2. Test all valves at the operating pressures at which the particular line will be used.

3. Test all valves for control operation as directed.

4. Field testing shall include optimization of opening and closing times of the valves. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

B. Preliminary Field Tests

1. General: Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components.

2. Scope: Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly.

3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation, as specified or otherwise directed.

C. Final Field Tests

1. Final field tests shall be conducted in accordance with the latest revision of AWWA C500.

2. Final field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.

3. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 46 00 00 – Equipment and General Provisions.

END OF SECTION

SECTION 40 05 59.20

REPLACEMENT SLUICE GATES

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. This section includes all labor, materials, tools, equipment and related items required to remove existing gates, stems, guides, operators and miscellaneous metals and furnish and install new heavy-duty sluice gates as indicated on the Drawings or specified in these Specifications.

B. Each gate shall be furnished and installed complete with anchor bolts, operating stem, gate lift operator, and other appurtenances as specified or needed to make a complete and operable installation.

1.02 RELATED WORK

A. Section 03 60 00 Grout

B. Section 05 05 23 Metal Fastenings

C. Section 05 10 00 Metal Materials

1.03 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA C560 – Standard for Cast-Iron Sluice Gates

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

1. ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shape

2. ASTM A436 - Standard Specification for Austenitic Gray Iron Castings

3. ASTM D 2000 - Standard Classification System for Rubber Products in Automotive Applications

4. ASTM B98 – Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes

5. ASTM B21 – Standard Specification for Naval Brass Rod, Bar and Shapes

6. ASTM B584 – Standard Specification for Copper Alloy Sand Castings for General Applications

C. American National Standards Institutes (ANSI):

1. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

2. ANSI B46.1 - Surface Texture and Gaging for Screw Threads

1.04 QUALIFICATIONS

A. All sluice gates shall be furnished by a manufacturer fully experienced, (minimum 5 years), reputable and qualified in the manufacture of the materials to be furnished.

B. Sluice gates shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications as applicable.

1.05 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Division I General Provisions and as specified herein, submit the following:

1. Shop Drawings - detailed custom drawings of gate assemblies with dimensional and mounting information and a listing of the materials of construction. General arrangement drawings and cut sheets are not considered acceptable drawings.

   a. Field verification of dimensions, elevations and assemblage.

   b. Fabrication, assembly and installation diagrams.

   c. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages (including any modifications to operator base mounting to existing structures).

   d. Anchor design calculations sealed by a Professional Engineer currently registered in the State of Georgia in accordance with specification section 05 05 23 – Metal Fastening.

2. Product Data:

   a. Manufacturer's literature, illustrations, specifications and engineering data.

   b. Lubricant Specification: Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment.

3. Support Design Information:

   a. Submit for record purposes only weight of each sluice gate and expected opening and closing thrust loads on the supporting structure.

4. Shop Test Results:

   a. Submit results of required shop tests.

5. Field Test Results:

   a. Submit a written report giving the results of required field tests.

6. Operation and Maintenance Data:

   a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.

PART 2 - PRODUCTS

2.01 GENERAL

A. Gates, stems, lifts and other appurtenances shall be the size, type, material and construction as shown on the drawings and specified herein.

B. Sluice gates shall be as manufactured by Rodney Hunt, Waterman, Hydro Gate, or approved equal.

C. Sluice gates shall be the rising stem type with manual operators, flat back mounted on wall thimbles or flanged wall pipe as indicated in the Drawings and of the sizes and rated seating and unseating heads as follows:

Sluice Gate ID	Structure Invert Elevation	Size/Shape	Seating Head (feet)	Installed Year	Manufacturer
B1	Inlet Str. B Elev. 1033.65ft.	42”x42” Square	14	1977	Rodney Hunt
C1-Left	Outlet Str. C Elev. 1034.00 ft.	30”x30” Square	14	1952	Armco
C3-Right	Outlet Str. C Elev. 1040.5 ft.	30”x30” Square	8	1952	Armco
D1-Right	Outlet Str. D Elev. 1035.17	42”x42” Square	13	1977	Rodney Hunt
D2-Left	Outlet Str. D Elev. 1038.87	42”x42” Square	10	1977	Rodney Hunt
E1-Right	Outlet Str. E Elev. 1034.00	48”wx42”h Rectangle	14	1980	Rodney Hunt
E2-Front	Outlet Str. E Elev. 1038.00	48”wx42”h Rectangle	10	1980	Rodney Hunt
E3-Left	Outlet Str. E Elev. 1042.00	48”wx42”h Rectangle	6	1980	Rodney Hunt

D. All component parts shall be of the type of material shown, and interchangeable where size and material are the same without grinding, chipping or special fitting in the field.

E. All mating and sliding parts shall be fully machined.

F. All sluice gate parts, including lift, shall be designed for the heads shown with a minimum safety factor of 5.

G. All materials used in the construction of the gate and appurtenances shall be the best suited for the application and shall be as follows.

Gate Part or Item	Trim	ASTM Standard Number
Anchor Bolts & Nuts	Stainless 316	276-Type 316
Frame, Slide and Guide Rails	Austenitic Gray Iron (Ni-Resist)	A-436-Type 2
Seating Faces	Bronze	B21
Wedges	Bronze	B584
Fasteners	Stainless 316	276-Type 316

Stem Block	Austenitic Gray Iron (Ni-Resist)	A-436-Type 2
Sill Plate	Austenitic Gray Iron (Ni-Resist)	A-436-Type 2
Seal	Rubber	D 2000
Retainer	Stainless 316	276-Type 316
Yoke	Austenitic Gray Iron (Ni-Resist)	A-436-Type 2
Stem	Stainless 316	276-Type 316

2.02 FRAME AND GUIDE RAILS

A. The frame and guide rails shall be of cast iron and cast integrally and shall be machined on all bearing and contact surfaces.

B. Frame and guides shall be designed for the maximum head indicated with a minimum safety factor of 5 with respect to tensile, compressive and shear strength.

C. Guides shall be of such length as to support at least one-half of the vertical height of the slide when in the open position

2.03 SLIDE

A. The slide shall be made of cast iron, with strengthening ribs where required, and a reinforced section to receive the seating faces.

B. The slide shall be designed for the maximum head indicated with a minimum safety factor of 5 with respect to tensile, compressive and shear strength.

C. The slide shall have tongues on each side extending its full length, and these tongues shall be accurately machined on contact surfaces.

D. Surfaces of the slide that come in contact with the seat facings and wedges shall be accurately machined. The maximum allowable clearance between the slide and slide guide shall be 1/16 inch.

E. A thrust-nut pocket shall be provided above the horizontal centerline of the slide reinforced by ribs. The thrust-nut pocket shall be drained.

2.04 SEATING FACES

A. Seating faces shall be made of strips of rolled or extruded bronze. They shall be firmly secured in finished grooves in the frame and slide faces in such a way as to ensure that they will remain in place, free from distortion and loosening during the life of the sluice gate.

B. These faces shall be of ample section and so finished that the maximum clearance between the seating surfaces, with the slide in the closed position shall be 0.004 inches.

2.05 SEALS

A. Resilient seals for flush-bottom gates shall be of natural or synthetic rubber.

B. Reclaimed rubber shall not be used.

C. Rubber compounds shall contain no more than 1.5 part of wax per 100 parts of rubber hydrocarbon.

D. Rubber compounds shall be free of vegetable oils, vegetable-oil derivatives, animal fats, and animal oils.

E. Rubber seals shall be resistant to microbiological attack, copper poisoning and ozone attack.

F. Design of the seal should be such as to provide tight shutoff.

G. Seals shall be mounted on the slide and shall be securely held in place with a retainer bar bolted to the slide leaving an unobstructed flush invert.

2.06 THRUST NUT

A. Gate shall be provided with a thrust nut for connecting the stem to the slide. It shall be of ample design to take the thrust developed during gate operation under the maximum operating head condition loads with a safety factor of 5 in opening and closing direction.

B. The thrust nut and slide shall be constructed to prevent turning off the thrust nut in the pocket in the slide.

2.07 WEDGING DEVICES

A. Sluice gate shall be equipped with adjustable side-wedging devices to provide contact between the slide and frame facings when the gate is in closed position.

B. All faces shall be accurately machined to give maximum contact and wedging action.

C. Wedges shall be fully adjustable and so designed that they will remain in the fixed position after adjustment.

2.08 ASSEMBLY BOLTS, STUDS, NUTS AND ANCHOR BOLTS

A. All assembly bolts, studs, nuts, and anchor bolts shall be of such size and spacing as required to provide for the design forces with a safety factor of 5.

B. Bolting on circular flanged-back gates shall mate with 125-pound drilling as specified in ANSI B16.1.

C. An adequate number of holes shall be provided in the flange on the back of the gate to prevent leakage under the design heads and to resist the shearing action caused by closing and opening forces.

2.09 WALL THIMBLES

A. Wall thimbles are existing. Rodney Hunt gates are shown as Type F Thimble. Armco gates are for Hardesty Model 50-10. Thimble faces may require surfacing, drilling and tapping to match newer equipment.

2.10 STEMS AND STEM COUPLINGS

A. Operating stems shall be of a size to safely withstand, without buckling or permanent distortion, stresses induced by normal operating forces.

B. Stems shall be fabricated from round bar stock of stainless steel and shall be provided with 29 degrees modified or full acme threads.

C. Stems composed of 2 or more sections shall be joined by stainless steel couplings threaded and keyed to stems, or couplings of the same material as the stems, pinned, bolted or welded and pinned to the stems.

2.11 STEM GUIDES

A. Stem guides shall be austenitic gray iron (Ni-Resist), with stainless steel bushings, and mounted on cast brackets.

B. Guides shall be adjustable in two directions and shall be so constructed that when properly spaced they will hold the stem in alignment and still allow enough play to permit easy operation.

C. Stem guide spacing shall be as recommended by the manufacturer, but in no case shall it exceed an l/r ratio of 200.

D. Brackets shall be attached to the wall by anchor bolts of sufficient strength to prevent twisting or sagging under load.

2.12 MANUAL OPERATOR FLOOR STANDS

A. Manual operation shall be by crank-operated floor stands or as shown on the plans.

B. Crank-operated type shall have gear reduction depending upon the lifting capacity required.

C. Each type shall be provided with a threaded cast bronze lift nut to engage the operating stem.

D. Tapered roller bearings shall be provided above and below a flange on the operating nut to support both opening and closing thrusts.

E. Floor stands shall operate the gates with not greater than a 40-pound pull on the crank.

F. Gears, where required, shall be steel or cast iron with machine-cut teeth designed for smooth operation.

G. The pinion shafts on crank-operated floor stands, either single or double, shall be supported on tapered roller bearings or needle bearings.

H. All components shall be totally enclosed in a cast iron case and cover.

I. Positive mechanical seals shall be provided on the operating nut and the pinion shafts where they extend from the cast iron case or gear box to retain lubricant and toexclude moisture and dirt.

J. Lubricating fittings shall be provided for the lubrication of all gears and bearings.

K. The removable crank shall be cast iron with a revolving brass grip.

L. Lugs shall be provided for operation by cordless drill.

M. Floor stands shall include a cast iron pedestal design to position the input shaft approximately 36 inches above the operating floor.

2.13 WORKMANSHIP

A. All parts in the sluice gate and accessories shall be accurately machined on mating and bearing surfaces.

B. All like parts, except the bronze seating surfaces shall be interchangeable so that replacement parts can be furnished at any time and attached in the field with a minimum of fitting, chipping or re-machining.

C. All parts shall conform to design dimensions and shall be free of defects of material and workmanship.

D. All attaching bolt holes shall be drilled accurately to layout indicated on the drawings.

E. All casting shall be clean and sound without defect capable of impairing their functions.

F. The seating facings shall be machined to a finish of 63 micro-inch. The applicable standard is ANSI B46.1.

G. All mating surfaces, such as guides-to-frame and frame-to-wall thimble, shall be machined flat.

2.14 SHOP TESTING

A. Before the final assembly, all seating and wedging surfaces shall be thoroughly cleaned of all foreign materials and final adjustments made.

B. With the gate fully closed, clearance between the seating faces shall be checked with a 0.004 inch thickness gauge. If this thickness gauge can be inserted between seating faces, wedging devices must be readjusted or the gate slide or gate frame or both re-machined, until insertion is no longer possible.

C. In the event of re-machining, clearances will again be checked as stated above.

D. After completion, all seating and wedging surfaces shall be thoroughly cleaned of all foreign materials and final adjustments made.

E. The sluice gate shall then be shop operated from the fully-closed to the fully-open position to verify that the assembly is workable.

PART 3 -- EXECUTION

3.01 STORAGE AND INSTALLATION

A. Sluice gates and equipment shall be stored and installed in accordance with the installation manual furnished by the gate manufacturer.

B. After installation, the completely assembled gate, stem, guides and lift shall be operated through one full cycle to demonstrate satisfactory operation.

C. Such adjustments as necessary will be made until operation is approved by the Engineer.

D. The gate shall be subjected to leakage tests and pass the standard requirements for maximum leakage as specified in AWWA C560

END OF SECTION

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SECTION 40 05 61
GATE VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

B. The Contractor shall furnish and install, complete with all assemblies and accessories, all gate valves shown on the Drawings, specified herein and as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.

C. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications.

1.02 SUBMITTALS

A. As required in Section 40 05 51 – Valves General, and Section 01 33 00 – Submittal Procedures.

B. The Contractor shall furnish to the Owner, through the Engineer, a Performance Affidavit, utilizing the format specified in Section 46 00 00 – Equipment General Provisions.

C. Performance tests shall be conducted in accordance with the latest revision of AWWA C500 and affidavits shall conform to the requirements of the Specifications.

PART 2 – PRODUCTS

2.01 GATE VALVES

A. Resilient wedge gate valves (GV-RW)

1. Size: 14-Inch through 54-Inch

a. Gate valves 14 inch through 54 inch, rated for 250 psig working pressure.

b. Non-rising stem (NRS) design, shall fully comply with the requirements of AWWA C515 for resilient-seated gate valves and shall be manufactured by Kennedy Valve, Clow, or equal.

c. Gate valve body, bonnet, and wedge shall be ductile iron conforming to ASTM A536, Grade 65. All pressure retaining joints shall be sealed with O-ring seals. Flat gaskets shall not be acceptable.

d. Stems and stem nuts shall be bronze. Stems shall contain integral thrust collars. NRS valves shall contain two O-rings above the stem thrust collar and one O-ring below the stem thrust collar. All stem O-rings shall be replaceable with valve in the full open position and subjected to full pressure. NRS stems shall have two low-friction thrust washers located above and below the stem collar to reduce operating friction.

e. Wedge shall be totally encapsulated with a permanently bonded rubber material. Rubber shall be suitable for use in raw water and shall be EPDM.

f. Provide stainless steel tracks, bronze rollers, and bronze scrapers on valves 24-inch and larger.

g. Waterway shall be smooth, unobstructed, and free of all pockets, cavities, and depressions in the seat area.

h. Body, bonnet, and stuffing plate shall be shop coated inside and out with a fusion bonded epoxy (10 mils minimum dry film thickness) complying with AWWA C550 and shall be NSF-61 certified. Damage surfaces shall be repaired in accordance with the manufacturer's recommendations.

i. Valves 18-inch and larger shall be equipped with a gearbox. Extensions, gearbox housing, and adapter plates shall be ductile iron conforming to ASTM A536, Grade 65.

j. Valves shall be flanged or mechanical joint as shown on the drawings. Provide 2-inch square standard AWWA operating nut unless otherwise shown on the Drawings or specified herein.

k. All valve assembly hardware shall be minimum 304 stainless steel.

END OF SECTION

SECTION 40 05 64
BUTTERFLY VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 – Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 BUTTERFLY VALVES (WATER SERVICE)

A. Butterfly valves (water service) shall be of the rubber-seated, tight-closing type conforming to the latest revision of AWWA C504. The manufacturer shall have a minimum of 5 years of experience in manufacturing butterfly valves of the sizes required in accordance with AWWA C504. All butterfly valves shall be the product of one manufacturer. Butterfly valves shall be as manufactured by Pratt, Mueller Co., DeZurik, GA Industries, or equal. Each valve shall be performance and leak tested as specified in AWWA C504 revised as follows: In addition to the testing requirements of AWWA C504, each butterfly valve shall be thoroughly cleaned and opened and closed at least three (3) times prior to testing. Certified copies of the test results shall be submitted to the Engineer for approval prior to shipment of the valve.

B. Butterfly valves shall be Class 150B, unless otherwise indicated in the valve schedules, and of the short body design with mechanical joint or flanged ends, as shown on the Drawings.

C. Valve bodies shall be epoxy coated cast iron conforming to ASTM A-126, Grade B, ASTM A-48, Class 40 or Ductile Iron ASTM A536, Grade 65-45-12. Where required to meet design operating conditions, valve bodies shall be manufactured of higher strength materials. Valve bodies shall have integral hubs for housing shaft bearings and seals.

D. Butterfly valves shall be of the concentric or eccentric shaft types. Valve discs shall be constructed of epoxy coated ductile iron, ASTM A536, Grade 65-45-12. Discs shall provide a full 360 degree seating surface with no external ribs transverse to flow, and shall comply with the latest revision of AWWA C504. The valve manufacturer shall furnish Shop Drawings which include end clearance dimensions when the disc is in the fully open position.

E. The resilient valve seat shall be synthetic rubber designed to seat against a pressure differential of 150 psi on either side of the valve, unless otherwise indicated. The resilient seat shall be mechanically attached to the valve disc or valve body. Any required seat attachment hardware shall be stainless steel. The resilient seat shall be capable of being adjusted or replaced in the field without moving the valve disc along the shaft axis or

removing the valve from the line. The mating seat surface shall be stainless steel or monel.

1. The seats shall be factory tested as per AWWA C504 at a test pressure of 150 psig, unless otherwise indicated, and post adjusted for differential pressures indicated herein.

F. Valve shafts shall be one-piece or two-piece units of stainless steel construction suitably sized to transmit the torques required to operate the valves under the conditions listed in the valve schedule with appropriate safety factor. Shafts shall be securely attached to valve disc by means of conservatively sized corrosion-resistant taper pins, threaded at one end and secured with lockwashers and nuts (i.e.: mechanically attached). Provide O-ring seal on taper pin if required to prevent leakage. Shaft key shall be constructed of corrosion-resistant material.

G. Shaft bearings shall be contained in the integral hubs of the valve body and shall be the permanently self-lubricated, corrosion resistant, sleeve type of teflon or heavy-duty bronze. The valve assembly shall be furnished with a factory set two-way thrust bearing designed to center the valve disc in the valve seat at all times. End cover bolts shall be of stainless steel construction.

H. The shaft seal shall be either the bronze cartridge type with at least two O-rings, monolithic V-Type, U-Cup Type, or pull down packing type. If monolithic V-Type, U-Cup Type, or pull down packings are utilized, it shall be self-adjusting, self-compensating type. Packing shall be as manufactured by Chevron, or equal. Butterfly valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator. For buried valves with pull down packing the packing gland cover assembly shall be heavy duty, soil and water resistant. Stuffing boxes for pull down packing shall have a depth sufficient to accept at least four rings of self-compensating type packing specifically selected for the operating pressures to be encountered. Stuffing box bolts, studs and nuts shall be stainless steel.

I. The "O" ring type shaft seal shall be contained in a removable bronze cartridge. The bronze cartridge shall be manufactured from ASTM B505 copper alloy UNS #C93200 and shall meet the requirements of AWWA C504 for bronze, Grade E. The "O" ring material shall be nitrile, BUNA-N rubber, as intended for use with potable water or wastewater and per ASTM D-2000 with a hardness of 70 Shore A Durometer.

J. Manual operators for butterfly valves 18-inches in diameter or larger shall be the worm gear type conforming to AWWA C504. Manual operators for butterfly valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators. Operators shall be equipped with adjustable AWWA limit stops, shall be sized according to Table IV for Class 150B, and shall require a minimum of 15 turns for 90 degrees or full stem valve travel. The capacity of the manual operator shall be adequate to drive the valve under the differential pressure of 150 psi and maximum anticipated flow, unless otherwise indicated in the appropriate valve schedule.

K. The manufacturer shall certify that the butterfly valves are capable of operating in continuous duty service under these pressures and flow conditions.

L. Each valve shall by hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.

M. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 06 20

PROCESS PIPE, VALVE, AND GATE SCHEDULES

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Reference Section 40 05 00 - Basic Mechanical Requirements.

1.02 PIPING SCHEDULES

A. Piping requirements for this Section are outlined on the Drawings and in the Piping Schedules. In the absence of a specified test pressure, pipe shall be tested at the greater of: 1) 150 percent of working pressure as determined by the Engineer or 2) 10 psig, unless the Schedule indicates no test is required.

B. If the pipe material is not shown on the Piping Schedule or otherwise specified, the following materials shall be used.

PIPE SIZE	MATERIAL	TYPE OF JOINT	CLASS/DESIGN	TEST PRESSURE
4-IN AND LARGER	DIP	FLANGED (EXPOSED)	CLASS 53	(1)
		RESTRAINED (BURIED)	PRESSURE CLASS 350	
LESS THAN 4-IN	PVC/CPVC (2)	SOCKET	SCH 80	(1)

(1) Test at 150 percent of working pressure or 10 psi, whichever is greater.
(2) For all PVC / CPVC designations, if piping is exposed to direct sunlight or if heat tracing is required, CPVC shall be used. Otherwise, PVC shall be used.

1.03 VALVE SCHEDULES

A. All valves shall be tagged by the manufacturer according to the control valve designations listed in this Section.

B. Valves not listed in this Section shall be manually operated, unless otherwise shown on the Drawings.

11-03-21

1.04 GATE SCHEDULES

A. Gates shall be tagged by the manufacturer according to locations listed in this Section.

WATER TREATMENT PLANT PIPING SCHEDULE

PIPE DESIGNATIONS		MATERIAL	BURIED PIPING		EXPOSED PIPING			DESIGN PRESSURE (PSI)[1]			
			TYPE OF JOINT	CLASS/ DESIGN	TYPE OF JOINT	CLASS/ DESIGN	HEAT TRACE[2]	WORKING	SURGE	RESTRAINT	FIELD TEST
RW	RAW WATER	DIP	RESTRAINED	PRESSURE CLASS 200	N/A	N/A	NO	60	70	60	150
SD	STORM DRAIN	RCP	PUSH-ON	IV	N/A	N/A	N/A	SECTION 33 05 39.23 / 40 05 33			
		DIP	RESTRAINED	PRESSURE CLASS 250	N/A	N/A	N/A				

1) Surge pressure is the maximum pressure in the system during a surge event. Restraint pressure shall be used to determine pipe joint design and if required, the size, number, material, and dimensions of tabs and threaded-rods and thrust blocking for thrust restraint of piping and piping system components specified.
2) Provide heat tracing and insulation as specified in Section 40 41 13 on all exposed outdoor piping indicated.
3) For all PVC / CPVC designations, if piping is exposed to direct sunlight or if heat tracing is required, CPVC shall be used. Otherwise, PVC shall be used.
4) Flanges shall be provided as shown on the drawings or as approved by the Engineer.

END OF SECTION

SECTION 46 00 00
EQUIPMENT GENERAL PROVISIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.

B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

C. The Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces with related mechanical, structural, electrical, instrumentation, and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as shown and specified.

D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.

E. The requirements of this section shall apply to equipment furnished under Divisions 40, and 46.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01 42 00 – References.

1.03 ACTION/INFORMATIONAL SUBMITTALS

A. Product Data: Comply with Section 01 33 00 – Submittals Procedures

B. Shop Drawings shall be submitted to the Engineer for all equipment in accordance with Section 01 33 00 – Submittal Procedures and shall include the following additional information:

1. Equipment name, identification number and specification number.

2. Performance characteristics and descriptive data.

3. Detailed equipment dimensional drawings and setting plans.

4. Piping schematics.

5. Equipment protective device details and connection diagrams.

6. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.

7. A list of spare parts and special tools to be provided.

8. Any additional information required to demonstrate conformance with the equipment specifications.

9. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

10. Shipment, delivery, handling, and storage instructions.

1.04 CLOESOUT SUBMITTALS

A. Submit warranty documentation in compliance with:

1. Section 01 33 00 – Submittal Procedures

2. Section 01 61 00 – Product Requirements and Options

B. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01 33 00 – Submittal Procedures and Section 01 78 23 Operation and Maintenance Data.

1.05 MAINTENANCE MATERIALS SUBMITTALS

A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:

1. Section 01 33 00 – Submittal Procedures

2. Section 01 78 23 – Operation and Maintenance Data

B. Comply with Section 01 78 43 – Spare Parts and Extra Materials:

1. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section.

2. Submit complete list of spare parts, extra stock materials, maintenance supplies and special tools required for maintenance for two years with unit prices and source of supply. Indicate number/quantity specified and furnished, manufacturer, part number, description,

C. Comply with Section 01 79 00 – Instructions to Owner's Personnel.

1.06 QUALTIY ASSURANCE SUBMITTALS

A. Factory testing plan.

B. Factory Test Results shall be submitted and approved prior to shipment of equipment.

C. Field testing plan.

D. Comply with Section 01 75 00 – Check Out and Start Up Procedures.

E. Preliminary field test data

F. Final field test data

1.07 GENERAL INFORMATION AND DESCRIPTION

A. All parts of the equipment furnished shall, be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new and shall conform to all applicable Sections of these Specifications.

B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.

C. Equipment and appurtenances shall be designed in conformity with specifications, codes and reference standards.

D. All bearings and moving parts shall be protected by bushings or other Engineer approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.

E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.

G. All machinery and equipment shall be safeguarded in accordance with the specifications, codes, and reference standards.

H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.

I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.

J. All manufactured items provided under this Section shall be of current manufacture and shall be the products of manufacturers specializing in the manufacture of such products.

1.08 EQUIPMENT WARRANTIES

A. Warranty requirements shall be as specified in Section 01 61 00 – Product Requirements and Options and Section 01 75 00 – Checkout and Startup Procedures. Warranty requirements are supplementary to the individual equipment specifications.

PART 2 – PRODUCTS

2.01 ANCHORS AND SUPPORTS

A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.

B. Anchor bolts and fasteners shall be furnished in accordance with Section 05 05 23 – Metal Fastening, and with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2-inch diameter. All anchor bolts, guard bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.

C. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6” high, unless otherwise shown on the Drawings and shall be doweled.

D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout). Non-shrink grout shall be as specified in Section 03 60 00 – Grout.

2.02 STRUCTURAL STEEL

A. Structural steel used for fabricating equipment shall conform to the requirements of Section 05 12 00 – Structural Steel.

B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

2.03 DISSIMILAR METALS

A. All dissimilar metals shall be isolated in accordance with Section 05 10 00 – Metal Materials and to the satisfaction of the Engineer.

2.04 GALVANIZING

A. Where required by the equipment specifications, galvanizing shall be performed in accordance with Section 05 05 13 – Galvanizing.

2.05 STANDARDIZATION OF GREASE FITTINGS

A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be “Zerk” type.

2.06 ELECTRICAL REQUIREMENTS

A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit, and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 26 specifications and the latest National Electric Code. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual pump specifications.

B. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.

2.07 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

A. Accessories, spare parts, and special tools shall be provided in accordance with Section 01 78 43 – Spare Parts and Extra Materials.

2.08 EQUIPMENT IDENTIFICATION

A. All mechanical equipment shall be provided with a substantial stainless-steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

B. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless-steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.

C. Nameplates shall not be painted over.

PART 3 – EXECUTION

3.01 SHOP TESTING

A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.

B. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.

C. A certified copy of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.

3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

A. Shipment, delivery, and handling of equipment and materials shall be in accordance with Section 01 65 00 – Product Delivery Requirements.

B. Storage of equipment and materials shall be in accordance with Section 01 66 00 – Product Storage and Protection Requirements.

3.03 MANUFACTURER’S FIELD SERVICES

A. Manufacturer’s field services shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.

B. The Contractor shall arrange for a qualified factory trained Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.

C. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections. Additional site visits may be required as described below and in the equipment specifications.

D. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection,

operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.

E. The manufacturer's Technical Representative shall provide the following services.

1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer’s requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.

2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.

3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. If equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

4. Training: Training shall be provided in accordance with Section 01 79 00 – Instruction of Owner Personnel.

5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the startup date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.

F. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

G. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.

H. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day the Technical Representative is at the project.

3.04 INSTALLATION

A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.

B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.

C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.

D. All equipment sections and loose items shall be match-marked prior to shipping.

E. For equipment that requires field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the equipment and motor prior to making piping connections or anchoring the equipment base. Alignment shall be as specified herein.

F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

3.05 ALIGNMENT

A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.

B. General Equipment Leveling: Non-rotating equipment shall be set level to +/- 1/16 inch per 10-foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims

shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one-inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.

C. Grouting

1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.

2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.

3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.

4. Finishing. Point the edges of the grout to form a smooth 45-degree slope.

5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.

6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.

D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.

E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint, and dirt.

3.06 FIELD TESTING

A. Field testing shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.

B. All equipment shall be set, aligned, and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer’s representative.

C. Preliminary Field Tests, Yellow Tag

1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:

    a. Verify that the equipment is free from defects.

    b. Check for alignment as specified herein.

    c. Check for direction of rotation.

    d. Check motor for no load current draw.

2. Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.

3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.

4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

D. Final Field Tests, Blue Tag

1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.

2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.

3. The tests shall prove that the equipment and appurtenances are properly installed.

E. Additional field testing recommended by the manufacturer shall be performed at no cost to Owner.

F. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments, and replacements at no additional cost to the Owner.

G. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed, and no further construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.

H. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.

I. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment specifications.

J. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

3.07 FAILURE OF EQUIPMENT TO PERFORM

A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.

B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.

C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.

D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.

E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.

F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.08 PAINTING

A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable paragraphs of Section 09 90 00 – Painting.

B. All shop coatings shall be compatible with proposed field coatings.

C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high-quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.

D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.09 WELDING

A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

END OF SECTION