

# FAIRVIEW CAMPUS

New Middle School and High School

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Tony Marchio Drive  
Townsend, DE 19734

**BID PAC 'B'**



**Volume 2 of 2**  
**DIVISION 2 - 34**  
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**VOLUME 2**

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## SECTION 033000 - CAST-IN-PLACE CONCRETE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings.
  - 2. Foundation walls.
  - 3. Slabs-on-grade.
  - 4. Suspended slabs.
- B. Related Sections include the following:
  - 1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.
  - 2. Division 2 Section "Cement Concrete Pavement" for concrete pavement and walks.
  - 3. Division 2 Section "Decorative Cement Concrete Pavement" for decorative concrete pavement and walks.

## 1.3 DEFINITIONS

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

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.

- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Samples: For waterstops and vapor retarder.
- E. Welding certificates.
- F. Qualification Data: For Installer, manufacturer, testing agency.
- G. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
  - 1. Aggregates.
- H. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Form materials and form-release agents.
  - 4. Steel reinforcement and accessories.
  - 5. Waterstops.
  - 6. Curing compounds.
  - 7. Floor and slab treatments.
  - 8. Bonding agents.
  - 9. Adhesives.
  - 10. Vapor retarders.
  - 11. Semirigid joint filler.
  - 12. Joint-filler strips.
  - 13. Repair materials.
- I. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- J. Field quality-control test reports.
- K. Minutes of preinstallation conference.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
  2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete,"
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete subcontractor.
  2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, [curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, vapor-retarder installation, steel reinforcement installation, floor and slab flatness and levelness measurement, and concrete protection.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### 2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. High-density overlay, Class 1 or better.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

### 2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

### 2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

### 2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class C.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
  1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

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

## 2.6 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

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

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2. Retarding Admixture: ASTM C 494/C 494M, Type B.

3. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C. Provide at exterior concrete slabs.

1. Products:

a. Boral Material Technologies, Inc.; Boral BCN.

b. Euclid Chemical Company (The); Eucon CIA.

c. Grace Construction Products, W. R. Grace & Co.; DCI.

d. Master Builders, Inc.; Rheocrete CNI.

e. Sika Corporation; Sika CNI.

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

1. Products:

a. Axim Concrete Technologies; Catexol 1000CI.

b. Boral Material Technologies, Inc.; Boral BCN2.

c. Grace Construction Products, W. R. Grace & Co.; DCI-S.

d. Master Builders, Inc.; Rheocrete 222+.

e. Sika Corporation; FerroGard-901.

E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Manufacturers:

- a. Bayer Corporation.
- b. ChemMasters.
- c. Conspec Marketing & Manufacturing Co., Inc.; a Dayton Superior Company.
- d. Davis Colors.
- e. Elementis Pigments, Inc.
- f. Hoover Color Corporation.
- g. Lambert Corporation.
- h. Scofield, L. M. Company.
- i. Solomon Colors.

2. Color: As selected by Architect from manufacturer's full range.

## 2.7 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).
  1. Products:
    - a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
    - b. Approved equal

## 2.8 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
  1. Products:
    - a. Fortifiber Corporation; Moistop Plus.
    - b. Raven Industries Inc.; Dura Skrim 8.
    - c. Reef Industries, Inc.; Griffolyn Type-85.
    - d. Stego Industries, LLC; Stego Wrap, 10 mils.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

## 2.9 FLOOR AND SLAB TREATMENTS

- A. Penetrating Liquid Floor Treatment: Provide at all exposed concrete surfaces to be treated to harden, seal and densify exposed concrete. Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products:
  - a. Dayton Superior Corporation; Day-Chem Sure Hard.
  - b. Euclid Chemical Company (The); Euco Diamond Hard.
  - c. L&M Construction Chemicals, Inc.; Seal Hard.
  - d. Meadows, W. R., Inc.; Liqui-Hard.

B. Stained Hardener with matching cure/sealer - Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement. Placing of hardener is followed by manufacturer's recommended water membrane-forming cure and seal: ASTM C 309

1. Products:
  - a. L&M Construction Chemicals, Inc.; Quartz Plate FF Hardener followed by Dress & Seal WB 30 per manufacturer's recommendations and specifications.
  - b. Scofield, L. M. Company; Lithochrome Color Hardener followed by Lithochrome Colorwax in matching color per manufacturer's recommendations and specifications.

## 2.10 CURING MATERIALS

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

1. Products:
  - a. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
  - b. Dayton Superior Corporation; Sure Film.
  - c. Euclid Chemical Company (The); Eucobar.
  - d. L&M Construction Chemicals, Inc.; E-Con.
  - e. Meadows, W. R., Inc.; Sealtight Evapre.
  - f. Sika Corporation, Inc.; SikaFilm.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

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

D. Water: Potable.

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

1. Products:
  - a. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
  - b. Euclid Chemical Company (The); Kurez DR VOX.
  - c. L&M Construction Chemicals, Inc.; L&M Cure R.

- d. Meadows, W. R., Inc.; 1100 Clear.
- e. Tamms Industries, Inc.; Horncure WB 30.

## 2.11 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- D. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

## 2.12 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

## 2.13 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
  2. Silica Fume: 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement at exterior conditions and 0.30 percent by weight of cement at interior conditions.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
  2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
  4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup. Coordinate color and location with Architect.

## 2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
  2. Maximum Water-Cementitious Materials Ratio: 0.50.
  3. Slump Limit: 3 inch minimum and 5 inch maximum (at point of concrete placement), plus or minus 1 inch (25 mm).
  4. Exposure Class: F2, S0, C1, P0
- B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
  2. Maximum Water-Cementitious Materials Ratio: 0.50.
  3. Slump Limit: 3 inch minimum and 5 inch maximum (at point of concrete placement), plus or minus 1 inch (25 mm).

4. Exposure Class: F2, S0, C1, P0

C. Slabs-on-Grade - Interior: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
3. Slump Limit: 3 inch minimum and 5 inch maximum (at point of concrete placement), plus or minus 1 inch (25 mm).
4. Exposure Class: F2, So, C1, P0

D. Slabs-on-Grade – Exterior (Exposed to Exterior Conditions): Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4500 psi (31 MPa) at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
3. Slump Limit: 3 inch minimum and 5 inch maximum (at point of concrete placement), plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.
5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
6. Exposure Class: F2, S0, C2, P0

E. Suspended Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.
2. Minimum Cementitious Materials Content: 470 lb/cu. yd. (309 kg/cu. m).
3. Slump Limit: 3 inch minimum and 5 inch maximum (at point of concrete placement), plus or minus 1 inch (25 mm). For pumpable concrete, slumps may be increased by 3 inches.
4. Exposure Class: F0, S0, C0, P0

## 2.15 FABRICATING REINFORCEMENT

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

## 2.16 CONCRETE MIXING

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

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
  2. Class C, 1/2 inch (13 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  1. Install keyways, reglets, recesses, and the like, for easy removal.
  2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  - 3. Install dovetail anchor slots in concrete structures as indicated.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 SHORES AND RESHORES

- A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.5 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair vapor retarders according to manufacturer's written instructions.
- C. Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

### 3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset

laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

### 3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
  - 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.8 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
  1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly to drains where required.
  5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### 3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete.

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

### 3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in 1 direction.
  - 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface and per ACI 117 “Specification For Tolerances For Concrete Construction & Materials”:
    - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20 as a minimum. Coordinate and specify minimum F(F) and F(L) values with flooring manufacturer during concrete pre-installation conference. Note: Flooring manufacturer may require very flat surface classification ( F(F) 45; F(L) 35) or super flat surface classification ( F(F) 60 ; F(L) 40). Coordinate locations and requirements prior to installation.
    - b. Provide maximum floor variation of 1/8” in 10’ and 1/16” in 1’ for terrazzo floor tile area or requirement as indicated by product manufacturer, whichever is more stringent.

- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

### 3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

### 3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
  - a. Water.
  - b. Continuous water-fog spray.
  - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
  - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
  - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
  1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### 3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  - 2. After concrete has cured at least 14 days, correct high areas by grinding.
  - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel reinforcement placement.
  2. Steel reinforcement welding.
  3. Headed bolts and studs.
  4. Verification of use of required design mixture.
  5. Concrete placement, including conveying and depositing.
  6. Curing procedures and maintenance of curing temperature.
  7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
  - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.
  - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
  - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
  - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
  - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive

- strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
  14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing. Values to be documented and provided to Architect and Flooring Manufacturer prior to placing flooring.

END OF SECTION 033000

**SECTION 03 3050**  
**INTEGRAL CONCRETE WATERPROOFING**

**PART 1 GENERAL**

## 1.01 SECTION INCLUDES

- A. Crystalline waterproofing admixture for concrete.
- B. Crystalline waterproofing treatment and waterstops of construction joints between successive concrete pours.
- C. The work of this section applies to concrete in the following locations:
  - 1. Auditorium floor slab
  - 2. Orchestra pit floor slab and side walls below grade.
  - 3. Elevator pit floor slab and side walls below grade.

## 1.02 RELATED SECTIONS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete materials and placement.
- B. Section 07 1300 - Sheet Waterproofing

## 1.03 REFERENCES

- A. ACI 305R - Hot Weather Concreting.
- B. ACI 306R - Cold Weather Concreting.
- C. ACI 308 - Standard Practice for Curing Concrete.
- D. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- E. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- F. ASTM C 666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
- G. ASTM E 329 - Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
- H. COE CRD-C 48 - Standard Test Method for Water Permeability of Concrete.

## 1.04 SUBMITTALS

- A. Submit manufacturer's certification that proposed materials, details and systems as indicated and specified fully comply with manufacturer's details and specifications. If any portion of Contract Documents do not conform to manufacturer's standard recommendations, submit notification of portions of design that are at variance with manufacturer's specifications
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Manufacturer's Certificates:
  - 1. Certify products meet or exceed specified requirements.
  - 2. Certify that proposed material is compatible with concrete mix design

## 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm with not less than 10 years experience manufacturing crystalline waterproofing of the type specified, able to provide test reports showing compliance

with specified performance characteristics, and able to provide on-site technical representation to advise on installation.

- B. Installer Qualifications: Experienced in work of the type specified in this section and acceptable to waterproofing manufacturer.
- C. Preinstallation Meeting: Before installation, conduct a meeting with the Contractor, waterproofing installer, installers of adjacent work and work penetrating waterproofing, and the waterproofing manufacturer's representative to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer' warranty requirements; notify the Owner and Architect/Engineer at least one week in advance of meeting.
  - 1. Trial mixes shall be carried out with proposed mix design to insure that mix meets all requirements set forth in the specification, prior to actual installation of concrete.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

#### 1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

#### 1.08 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard warranty document executed by authorized company official; warranty period: 25 years commencing on Date of Substantial Completion.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Manufacturer:
  - 1. Xypex Chemical Corp., 13731 Mayfield Pl. Richmond, BC, Canada V6V 2G9; 800-961-4477; Tel: 604-273-5265; Web: www.xypex.com.
  - 2. AQUAFIN, Inc. 505 Blue Ball Rd., #160, Elkton, MD, 21921 (800) 394-1410 or (410) 392-2300, Fax (410) 392-2324; Web: www.aquafin.net.
  - 3. Kryton International Inc. 1645 East Kent Avenue, Vancouver BC V5P 2S8; 800-267-8280; Tel: 604-324-8280; Fax: 604-324-8899; Web: www.kryton.com.
- B. Requests for substitutions will be considered in accordance with provisions of Division 1.

#### 2.02 MATERIALS

- A. Product: Xypex Admix C-500, C-1000 or C-2000 manufactured by Xypex Chemical Corp
- B. Product: Aquafin®-IC ADMIX manufactured by AQUAFIN, Inc.
- C. Product: KIM manufactured by Kryton International Inc
- D. Permeability: No measurable leakage through waterproofed concrete, when tested in accordance with COE CRD-C 48 at 350 feet (106 m) of head or 150 psi (1034 kPa).
- E. Chemical Resistance: Minimum 20% less weight loss compared to untreated specimen after exposure to 5% sulfuric acid for 70 days, when tested as follows:

- F. Test specimens consisting of concrete made with admixture dosage rates (to weight of cement) of 3 percent, 5 percent, and 7 percent, and a control sample prepared without admixture.
- G. Compressive Strength: At least 10 percent increase in strength compared to samples prepared without admixture, when tested in accordance with ASTM C 39/C 39M after 28 days.

### 2.03 ACCESSORIES

- A. Waterstops, cold-joint primer, grout and sealants:
  - 1. Provide compatible materials manufactured by the integral concrete waterproofing manufacturer.

## **PART 3 EXECUTION**

### 3.01 CONCRETE MIXING AND PLACING

- A. Comply with requirements of Section 03 3000.
- B. Make and test trial mixes under project conditions to determine setting time and strength of concrete; obtain manufacturer's recommendations regarding mix design, project conditions, and dosage rate.
- C. Add waterproofing admixture at time of batching and blend thoroughly, following manufacturer's instructions.
- D. In hot weather comply with ACI 305R; in cold weather comply with ACI 306R; use monomolecular film (evaporation retardant) on slabs during hot, dry, or windy conditions.
- E. Moist cure concrete in accordance with ACI 308; if moist curing is not possible, use curing compound complying with ASTM C 309.

### 3.02 CONSTRUCTION JOINTS

- A. Comply with manufacturer's instructions, including technical bulletins, catalog installation instructions, and product packaging labels.
- B. Verify substrate conditions installed as specified in Section 03 3000 - Cast-in-Place Concrete are acceptable for product installation in accordance with manufacturer' instructions; do not install unless substrate and ambient air temperature are within range acceptable to waterproofing manufacturer.
- C. Prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions.
- D. Clean laitance, dirt film, paint, coatings or other foreign matter harmful to the performance of waterproofing from surfaces of cured concrete to be treated.
- E. Mix materials in accordance with manufacturer's instructions.
- F. Follow manufacturer's instructions for cold joint and waterstop installation.

### 3.03 FIELD QUALITY CONTROL

- A. Do not cover admixture treated concrete with other construction until it has been observed by manufacturer's field representative and Architect/Engineer.
- B. After removal of forms, patch and repair honeycombing, rock pockets, tie holes, faulty construction joints, cold joints, and cracks using waterproofing admixture manufacturer's recommended procedures.
- C. Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of concrete batching and product installation in accordance with manufacturer's instructions.
- D. Flood test areas that are capable of holding water after end of curing period.

1. Plug or dam drains.
2. Test slabs by constructing temporary dams where necessary, at least 2 inches (50 mm) high, and filling with 2 inches (50 mm) of water.
3. Let water stand for 24 hours.
4. Repair leaks and retest until no leaks are observed.

3.04 CLEANING AND PROTECTION

- A. Protect installed concrete from damage during construction.
- B. When backfilling occurs less than 7 days after installation, use moist backfill material.
- C. Do not apply paint or other coatings for at least 21 days; before applying coatings neutralize waterproofed surface as recommended by waterproofing manufacturer.

**END OF SECTION**

**SECTION 04 2000**  
**UNIT MASONRY****PART 1 GENERAL**

## 1.01 SECTION INCLUDES

- A. Concrete Block.
- B. Split-face concrete block.
- C. Ground-face concrete block.
- D. Clay Facing Brick.
- E. Mortar and Grout.
- F. Reinforcement and Anchorage.
- G. Lintels.
- H. Accessories.

## 1.02 RELATED REQUIREMENTS

- A. Division 1 - Administrative Requirements: Preconstruction meeting.
- B. Division 1 - Quality Requirements: The Owner will engage an Independent Testing and Inspection Agency to verify the adequacy of the Contractor's quality control.
  - 1. Before concealing the work behind the brick veneer, obtain the required inspection from a representative of the Owner's independent testing and inspection agency.
- C. Division 1 - Quality Requirements: Mock-up:
  - 1. Construct mock-ups where indicated on the drawings, incorporating all components specified for the location.
  - 2. Demolish mock-up when directed by Architect, and remove debris from the site.
- D. Section 047200 - Cast Stone Fabrications
- E. Section 04 7313 - Calcium Silicate Manufactured Stone Masonry
- F. Section 05 5000 - Metal Fabrications: Loose steel lintels.
- G. Section 07 1113 - Bituminous Dampproofing: Dampproofing masonry surfaces.
- H. Section 07 1300 - Sheet Waterproofing: Waterproofing masonry surfaces.
- I. Section 07 2100 - Thermal Insulation: Insulation for cavity spaces.
- J. Section 07 6200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- K. Section 07 8400 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
- L. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

## 1.03 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.

- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- E. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- F. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.
- G. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
- H. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- I. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- J. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
- K. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- L. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- M. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- N. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.
- O. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.
- P. ASTM C1072 - Standard Test Method for Measurement of Masonry Flexural Bond Strength; 2013.
- Q. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2008).
- R. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2014.
- S. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2014.
- T. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2005.
- U. UL (FRD) - Fire Resistance Directory; current edition.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting two weeks before starting work of this section; require attendance by all relevant installers.
- B. Refer to Section 01 3000 - Administrative Requirements for additional information.

#### 1.05 SUBMITTALS

- A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, masonry accessories, and cleaning products including application .
- B. Samples: Submit four samples of decorative block and facing brick units to illustrate color, texture, and extremes of color range.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements, including referenced material standards and fire ratings.
- D. Shop Drawings: Provide shop drawings of vertical wall reinforcement and bond beam reinforcement. Submit, with copies to the Owner's Independent Testing and Inspection Agency, shop drawings for reinforcing detailing fabrication, bending, and placement of unit

masonry reinforcing bars. Show details of construction, including dimensioned drawings, plans, elevations, sections, and details of components to be incorporated into Work including, but not limited to, the following:

1. Flashing System: Large-scale details for each element of flashing system showing layout, profiles, methods of joining, and anchorage details; including lintel units, shelf units, corner units, end dam units, drip edges, conditions showing interface and relationship to adjacent materials, and other special applications.
2. Fabricated Flashing: Detail corner units, end-dam units, drip edges, and other special applications.
3. Anchors, Ties, and Accessories: Show sizes, coursing, and locations.
4. Reinforcing: For masonry reinforcing bars; comply with ACI 315, "Details and Detailing of Concrete Reinforcement" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement. Show elevations of reinforced walls.

#### 1.06 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For each type of masonry unit, cementitious materials, and accessories required. Include data on material properties material test reports substantiating compliance with requirements. For brick, include test report for efflorescence according to ASTM C 67.
  1. Provide test reports based on testing within previous two years.
- B. Material Certificates: Submit material certificates for the following, signed by manufacturer and Contractor. Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards.
  1. Each type of masonry unit.
  2. Cementitious materials. Include brand, type, and name of manufacturer. Provide certifications from manufacturer that no admixtures have been added to cementitious materials.
  3. Grout mixes. Include description of type and proportions of ingredients.
  4. Each material and grade indicated for reinforcing bars.
  5. Each type and size of joint reinforcement.
  6. Each type and size of anchors, ties, and metal accessory.
- C. Mix Designs: Submit material test reports for the Owner's Independent Testing and Inspection Agency, indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements.
  1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content. Include description of type and proportions of mortar ingredients.
  2. Include test reports, according to ASTM C 1019 for grout mixes required to comply with compressive strength requirement. Include description of type and proportions of grout ingredients.
- D. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 01 6000 - Product Requirements, for additional provisions.
  2. Extra Pre-Faced Units: 50 of each type, size, and color combination.

## 1.07 QUALITY ASSURANCE

- A. **Installer Qualifications:** The unit masonry work to be by a single firm specializing in exterior wall masonry work, for a period of not less than 5 years, so that there will be undivided responsibility in this single firm for such work.
1. The Installer must be experienced with work comparable to the work shown and specified and who has completed projects with a successful in-service performance for a period of not less than 5 years.
  2. The Installer shall engage experienced and qualified subcontractors to perform any part of the masonry work which he is not equipped or qualified to perform properly with his own forces.
- B. **Standards:** Comply with the applicable provisions and recommendations of the following standards below, where standards conflict, the more stringent shall apply, and where a conflict between any stated standard and a project specific requirement of the specifications arise, the more stringent provision shall prevail.
1. National Concrete Masonry Association (NCMA): "TEK" Information Series.
  2. American Concrete Institute (ACI):
    - a. ACI 530/ASCE 5/TMS 402: "Building Code Requirements for Masonry Structures."
    - b. ACI 530.1/ASCE 6/TMS 602: "Specifications for Masonry Structures."
  3. Brick Industry Association (BIA) "Technical Notes on Brick Construction."
  4. Underwriters Laboratories, Inc. (UL) "Fire Resistance Ratings."
  5. American Society for Testing and Materials (ASTM) E 2266 "Standard Guide for Design and Construction of Low-Rise Frame Building Wall Systems to Resist Water Intrusion."
- C. **Source Limitations for Masonry Units:** Obtain exposed masonry units of a uniform texture and color, through one source from a single manufacturer for each product required.
- D. **Source Limitations for Mortar Materials:** Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- E. **Owner's Independent Testing and Inspection Agency:** The Owner will engage a qualified independent testing and inspection agency to perform preconstruction testing indicated below for field quality control. Payment for these services will be made by Owner. Independent testing agency to coordinate submittal of "Special Inspections" testing documentation for State of Delaware (State) review and approval.
1. The Contractor is responsible for the expense of testing or inspection resulting as a consequence of the following:
    - a. Work not evidencing compliance with this specification.
    - b. Testing to verify the adequacy of work done without prior notice, improper supervision, or contrary to standard construction practice.
  2. **Contractor's Responsibilities:**
    - a. Furnish labor required to facilitate testing.
    - b. Provide materials, samples and access to materials as required for testing.
    - c. Provide a complete set of shop and erection drawings, including revisions to previous Architect reviewed submittals.
  3. **Owner's Independent Testing and Inspection Agency's Duties:**
    - a. The Owner's Independent Testing and Inspection Agency shall conduct the following tests and inspections, interpret them, evaluate the results for compliance with the specifications, and report the findings to the Architect, Owner, Contractor, and Local Building Authority, as their interests may appear.

- 1) Inspection and testing shall be in accordance with ACI requirements for masonry (ACI 530 and ACI 503.1) for the following inspections:
    - (a) Observation, sampling and placing of masonry units used in all reinforced masonry construction.
    - (b) Inspection reports during reinforced masonry erection.
    - (c) Observations of reinforcement condition, size and placement for compliance with ACI 530.
    - (d) Ambient temperature during reinforced masonry erection.
    - (e) Inspection of reinforced masonry materials to verify compliance with ACI 530.1.
    - (f) Prism testing of masonry.
    - (g) Observation of proportioning, mixing, consistency of mortar and grout for compliance with ACI 530.1.
    - (h) Observation of application of mortar, grout and masonry units for compliance with ACI 530.1.
    - (i) Observation of installation of anchors for compliance with ACI 530.
  - b. Tests shall be conducted at the start of the job, using materials and mixes sampled at point of deposit.
  - c. Testing of Mortar: The Owner's Independent Testing Laboratory shall verify mix consistency by daily testing in accordance with ASTM C780. Test shall establish specific and overall performance characteristics of the mortar system. Test reports shall be submitted to the Owner / Architect for review under the provisions of the Division 01 section under "General Requirements".
  - d. Test of grout for reinforced masonry for compliance with ASTM C 476 requirements for the types specified and strength shown, conduct and report the following:
    - 1) Compressive strength (ASTM C 1019); lab cure and break at a time increment of one at 7 days, and two at 28 days; a minimum of 1 field test shall be made for each 5000 square feet of reinforced CMU wall. Make no less than 3 tests.
  - e. Preliminary Test of Concrete Masonry Design Strength: With sufficient time, and not less than 28 days prior to the start of reinforced masonry construction, test for the compressive concrete masonry design strength ( $f'_m$ ) as specified. The value of  $f'_m$  shall be determined by tests of masonry assemblies (prisms) in accordance with ACI 530.1. Not less than five prisms shall be taken as 8 inches for reinforced CMU.
  - f. Field Tests of Concrete Masonry Design Strength: During construction, the value of the compressive concrete masonry design strength ( $f'_m$ ) shall be verified by field tests in accordance with the ACI and ASTM standards. A minimum of one field test shall be made for every 5000 square feet of reinforced CMU wall. Not less than three prisms shall be made for each field test. The thickness of the prisms shall be taken as 8 inches for the reinforced CMU.
- F. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

#### 1.08 MOCK-UP

- A. Construct a masonry wall as a mock-up panel; include:
  1. Mortar and accessories.
  2. Structural backup.
  3. Flashings.

4. Wall insulation.
  5. Brick watertable.
  6. (1) sample window unit with jack arch and cast stone window sill.
- B. Mockup shall include corner and return wall.
  - C. Refer to Section 01 4000 - Quality Requirements for additional information. See drawings for dimensions and extent of mock-up.
  - D. Locate where directed.
  - E. Mock-up may not remain as part of the Work.

#### 1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
  1. Deliver masonry veneer units to the jobsite on covered banded pallets with cardboard between layers. Store pallets in single stacks on level ground and cover with waterproof covering to protect the units from inclement weather. Handle masonry veneer units carefully to avoid breakage and damage to the finished surfaces.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided. During cold weather stockpile aggregates so that it may be possible to heat them for use in mixing mortar in compliance with ACI recommendations for cold weather masonry practices.
- E. Deliver pre-blended dry mortar mix, if used for the project, in moisture-resistant containers designed for use with dispensing silos. Store pre-blended dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil. Do not use metal reinforcing or ties having loose rust or other coatings, including ice, that will reduce rust or destroy bond.

#### 1.10 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress. Prevent excess moisture from entering work in progress.
  1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
  2. Protect door and window frames and exposed metal flashings from damage.
- B. Stain Prevention: Prevent mortar and soil from staining the face of masonry to be left exposed. Immediately remove mortar and soil that come in contact with such masonry.
  1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  2. Protect sills, ledges, and projections from mortar droppings.
  3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements: Do not use metal reinforcing or ties having loose rust or other coatings that will reduce or destroy bond. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6 and ACI 530/ASCE 5 and the following requirements:
1. If air temperature falls below 40 deg F, mixing water shall be heated.
  2. If the air temperature falls between 20 deg F and 32 deg F inclusively, sand and water shall be heated.
  3. If the air temperature falls below 20 deg F, in addition to the requirements of the preceding sub-paragraph, masonry units shall be heated, and heated enclosures shall be used with a minimum temperature of 40 deg F.
  4. Masonry shall be protected from freezing for 24 hours after laying.
- D. Hot-Weather Requirements: When ambient temperature exceeds 100 deg F (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar. Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

#### 1.11 DEFINITIONS

- A. Exterior: Areas exposed to the elements and areas located in unconditioned spaces
- B. Interior: Areas located in conditioned spaces

### **PART 2 PRODUCTS**

#### 2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
  1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on the drawings for specific locations.
  2. Special Shapes: Provide non-standard blocks configured for corners, lintels, control joint edges, jambs, sash, acoustical units, and other detailed conditions.
  3. Load-Bearing Units: ASTM C90, lightweight.
    - a. Hollow block, as indicated.
- B. Decorative Concrete Masonry Units
  1. Ground Face and Split Face Block: ASTM C 90:
    - a. Size:
      - 1) Size: Standard units with nominal face dimensions of 16 x 8 inches and nominal depths as indicated on the drawings for specific locations.
    - b. Pattern and Texture:
      - 1) Pattern: ground face and split face finish.
    - c. Color: To be selected from full range of manufacturer's standard colors.
  2. Shapes: Provide special shapes indicated, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  3. Manufacturers:
    - a. Basis of Design Ground Face Product: Oldcastle Building Products, Trenwyth Trendstone.

- 1) Subject to compliance with requirements, products by the following manufacturers are also acceptable:
  - (a) New Holland Concrete
  - (b) Fizzano Brothers; Groundface
- b. Basis of Design Split Face Product: Oldcastle Building Products, Split Face.
  - 1) Subject to compliance with requirements, products by the following manufacturers are also acceptable:
    - (a) New Holland Concrete
    - (b) Fizzano Brothers; Split Face
  - c. Substitutions: See Section 01 6000 - Product Requirements.
- C. Units with Integral Water Repellent: Provide exterior concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
  1. Performance of Units with Integral Water Repellent:
    - a. Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
      - 1) No water visible on back of wall above flashing at the end of 24 hours.
      - 2) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
      - 3) No more than 25 percent of wall area above flashing visibly damp at end of test.
    - b. Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
    - c. Compressive Strength: ASTM C1314; maximum 5 percent decrease.
    - d. Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
  2. Use only in combination with mortar that also has integral water repellent admixture.
  3. Use water repellent admixtures for masonry units and mortar by a single manufacturer.

## 2.02 BRICK UNITS

- A. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
  1. Manufacturer: Glen Gery Corporation: [www.glengery.com](http://www.glengery.com).
  2. Color and texture: "Ravenna", sand finish .
  3. Actual size: 15-5/8" long x 3-5/8" high, x 3-5/8" deep.
  4. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect:
    - a. Corner brick units (custom angle).
    - b. Lipped brick at horizontal relieving angles.
    - c. Jack arch units .
    - d. Circular arch units.
    - e. Soldier course units with solid corners.
    - f. Water table units, including inside and outside corner units.
  5. Substitutions: See Section 001600 - Product Requirements.

## 2.03 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: not permitted.
- B. Portland Cement: ASTM C150/C150M, Type I or Type II, without air entrainment.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Mortar Aggregate: ASTM C144: sand.
- E. Grout Aggregate: ASTM C404.

- F. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
  - 1. Color(s): To match Architect's sample(s) when incorporated into specified mix design(s).
- G. Water: Clean and potable.
- H. Accelerating Admixture: Not permitted.
- I. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
  - 1. Use only in combination with concrete masonry units manufactured with integral water repellent admixture.
  - 2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
  - 3. Meet or exceed performance specified for water repellent admixture used in masonry units.
    - a. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
    - b. Master Builders, Inc.; Rheopel
    - c. Amerimix, an Oldcastle brand; AMX 410: [www.amerimix.com](http://www.amerimix.com).

#### 2.04 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
  - 1. Blok-Lok Limited: [www.blok-lok.com](http://www.blok-lok.com).
  - 2. Hohmann & Barnard, Inc (including Dur-O-Wal brand): [www.h-b.com](http://www.h-b.com).
  - 3. WIRE-BOND: [www.wirebond.com](http://www.wirebond.com).
- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure. . Provide in lengths of not less than 10 feet (3 m),with prefabricated corner and tee units.
- E. Multiple Wythe Joint Reinforcement: Truss type; fabricated with moisture drip; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure. Provide in lengths of not less than 10 feet (3 m),with prefabricated corner and tee units.
- F. Adjustable Multiple Wythe Joint Reinforcement: Truss type with adjustable ties spaced at 16 in on center ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face. Provide in lengths of not less than 10 feet (3 m),with prefabricated corner and tee units.
  - 1. Vertical adjustment: Not less than 3-1/2 inches.

- G. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
  - 1. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
- H. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch thick, adjustable, eye and pintle type, stainless steel, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in.
- I. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, Stainless Steel Wire: ASTM A 580/A 580M, AISI Type 304 and / or Stainless Steel Sheet: ASTM A 167, A 240, or A 666, AISI Type 316..
  - 1. Anchor plates: Not less than .093 inch thick, designed for fastening to structural backup through sheathing by two fasteners.
  - 2. Pintles: Trapezoidal, or rectangular shape shape, 0.1875 inch thick.
  - 3. Vertical adjustment: Not less than 2 inches.
  - 4. Manufacturers:
    - a. HB-200-X anchor by Hohmann & Barnard, Inc.(/www.h-b.com)

## 2.05 FLASHINGS

- A. See Section 076200 - Sheet Metal Flashing and Trim.

## 2.06 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding.
- C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, dual level, trapezoidal shape and designed to prevent mortar droppings from clogging cavity weeps and allow proper cavity drainage.
  - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
    - a. Manufacturers:
      - 1) Mortar Net Solutions; MortarNet with Insect Barrier: [www.mortarnet.com](http://www.mortarnet.com).
    - b. Locations: At flashing locations in brick veneer walls.
- D. Cavity Weeps : Polyester mesh.
  - 1. Manufacturers:
    - a. CavClear/Archovations, Inc: [www.cavclear.com](http://www.cavclear.com).
    - b. Mortar Net Solutions: [www.mortarnet.com](http://www.mortarnet.com).
    - c. Colors: selected from manufacturers standard range.
- E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.
- F. Steel Shelf Angles and Lintels: galvanized, see Section 05 1200 - Structural Steel Framing and Section 05 5000 - Metal Fabrications.
- G. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142inch (3.6mm) steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.

## 2.07 MORTAR AND GROUT MIXES

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
  - 1. Masonry below grade and in contact with earth: Type S.
  - 2. Exterior, loadbearing masonry: Type S.
  - 3. Exterior, non-loadbearing masonry: Type N.
  - 4. Interior, loadbearing masonry: Type S.
  - 5. Interior, non-loadbearing masonry: Type N.
- B. Mortar Type S: minimum 1800 psi, ASTM C 270.
- C. Mortar Type N: One (1) part Portland Cement, one (1) part hydrated lime, and six (6) parts sand.
- D. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
- E. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 of ACI 530.1/ASCE 6/TMS 602 and ACI 530/ASCE 5 for dimensions of grout spaces and pour height. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.
- F. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- G. Mixing: Use mechanical batch mixer and comply with referenced standards.

## 2.08 SOURCE QUALITY CONTROL

- A. Owner may engage a qualified independent testing agency to perform source quality-control testing indicated below. Payment for these services will be made by Owner.
- B. Brick Tests: For each type and grade of brick indicated, units will be tested according to ASTM C 67.
- C. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

## **PART 3 EXECUTION**

### 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

### 3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

### 3.03 INSTALLATION - GENERAL

- A. Comply with ACI 530.1/ASCE 6, ACI 530/ASCE 5, and other requirements indicated applicable to each type of installation included in Project.

- B. Use full size units without cutting, if possible.
  - 1. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges.
  - 2. Allow units to dry before laying unless wetting of units is specified.
  - 3. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
  - 1. Mix units from several pallets as they are placed.
- D. Wetting of Brick:
  - 1. Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67.
  - 2. Allow units to absorb water so they are damp but not wet at time of laying.
- E. Cover tops of all partially completed walls at end of day to protect completed work and prevent water from entering the cavity.
- F. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

#### 3.04 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

#### 3.05 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 3. Mortar Joints: Concave.
- D. Brick Units:
  - 1. Bond: Running.
  - 2. Coursing: Two units and two mortar joints to equal 8 inches.
  - 3. Mortar Joints: Concave.

#### 3.06 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners.

- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Cut mortar joints flush where wall tile is scheduled, cement parging is required, or resilient base is scheduled.
- J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### 3.07 WEEPS

- A. Install weeps in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
- B. Place weeps directly on flashing.
- C. Do not strike mortar across bottom of weep.
  - 1. If mortar is struck across weep, remove and replace weep.

### 3.08 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar diverter at base of cavity full width of air space and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

### 3.09 REINFORCEMENT AND ANCHORAGE - GENERAL

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Reinforce joint corners and intersections with strap anchors 16 inches on center.
- F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 16 inches horizontally and 16 inches vertically.

### 3.10 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHER MASONRY

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.

### 3.11 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

### 3.12 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 16 inches horizontally and 16 inches vertically.

### 3.13 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 8 inches, minimum, to form watertight pan at non-masonry construction.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Seal lapped ends with a minimum of two beads of continuous sealant from leading edge of horizontal surface across and up entire height of vertical/sloped surface. Seal penetrations of flashing before covering with mortar.
  - 4. Fold flashing to create end dams at discontinuous ends. Turn up one course.
  - 5. Seal penetrations of flashing materials at cast stone and other anchors with compatible sealant or mastic.
- B. Extend metal flashings flush with the exterior face of masonry. Install flashing in two beads of butyl joint sealer Type 3 below flashing to prevent moisture migration under flashing. Refer to Section 07 9200 - Joint Sealants.
- C. Lap end joints of metal flashings at least 6 inches (152 mm) and seal watertight with Sealant Type 3.
  - 1. Refer to Sections 07 6200 - Sheet Metal Flashing and Trim and 07 9200 - Joint Sealants.

### 3.14 LINTELS

- A. Install loose steel lintels over openings.
- B. Maintain minimum 8 inch bearing on each side of opening.

### 3.15 GROUTED COMPONENTS

- A. Reinforce bond beams as noted on the Contract Drawings.
- B. Lap splices minimum 24 bar diameters.

- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.
- E. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.
- F. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

### 3.16 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
- C. Size control joints as indicated on drawings; if not indicated, 3/8 inch wide and deep.
- D. Form expansion joint as detailed on drawings.

### 3.17 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames, window frames, anchor bolts, plates, and louvers and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
  - 1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

### 3.18 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

### 3.19 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves, grounds, and other items. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### 3.20 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for conformance to requirements of this specification.

- C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

### 3.21 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

### 3.22 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

**END OF SECTION**

**SECTION 07 1113**  
**BITUMINOUS DAMPPROOFING**

**PART 1 GENERAL**

## 1.01 SECTION INCLUDES

- A. Bituminous dampproofing.
- B. Protection boards.
- C. Drainage panels.

## 1.02 REFERENCE STANDARDS

- A. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2016).
- B. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2011).
- C. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2013.

## 1.03 SUBMITTALS

- A. Product Data: Provide properties of primer, bitumen, and mastics.
- B. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

## 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of experience.

## 1.05 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

**PART 2 PRODUCTS**

## 2.01 BITUMINOUS DAMPPROOFING

- A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
  - 1. Composition - Vertical Application: ASTM D1227 Type III or ASTM D1187/D1187M Type I.
  - 2. VOC Content: Not more than permitted by local, State, and federal regulations.
  - 3. Applied Thickness: 1/16 inch, minimum, wet film.
  - 4. Products:
    - a. W. R. Meadows, Inc; Sealmastic Emulsion Type I (spray-grade): [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

## 2.02 BITUMEN MATERIALS

- A. Cold Asphaltic Type:
  - 1. Bitumen: Emulsified asphalt, ASTM D1227; unreinforced (Type III).

2. Asphalt Primer: ASTM D41/D41M, compatible with substrate.

### 2.03 ACCESSORIES

- A. Drainage Panel: 1/4 inch thick formed plastic, hollowed sandwich.
- B. Protection Board: 1/8 inch thick biodegradable hardboard.

## **PART 3 EXECUTION**

### 3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

### 3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive dampproofing.
- B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
- C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

### 3.03 APPLICATION

- A. Foundation Walls: Apply two coats of asphalt dampproofing.
- B. Perform this work in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- C. Prime surfaces at a rate approved by manufacturer for application indicated, and allow primer to dry thoroughly.
- D. Apply bitumen by spray application.
- E. Apply bitumen in one coat, continuous and uniform, at a rate of 25 sq ft/gal per coat.
- F. Apply from 2 inches below finish grade elevation, or below first course of face brick, down to top of grade beam at locations where two or more CMU courses are below grade.
- G. Seal items watertight with mastic, that project through dampproofing surface.
- H. Place drainage panel directly over dampproofing, butt joints, place to encourage drainage downward.
- I. Place protection board over drainage panel, butt joints, and adhere with mastic.
- J. Scribe and cut boards around projections, penetrations, and interruptions.

**END OF SECTION**

**SECTION 07 1300**  
**SHEET WATERPROOFING****PART 1 GENERAL**

## 1.01 SECTION INCLUDES

- A. Sheet Waterproofing:
  - 1. Self-adhered modified bituminous sheet membrane.
  - 2. Self-adhered HDPE sheet membrane.
- B. Drainage panels and protection board.

## 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate.
- B. Section 04 2000 - Unit Masonry: CMU substrate.
- C. Section 07 9200 - Joint Sealants: Sealing moving joints in waterproofed surfaces that are not required to be treated in this section.

## 1.03 ABBREVIATIONS

- A. HDPE - High-Density Polyethylene.
- B. NRCA - National Roofing Contractors Association.

## 1.04 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).
- B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).
- C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2012.
- D. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2010).
- E. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008 (Reapproved 2015).
- F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
- G. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 1993 (Reapproved 2014).
- H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- I. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).
- J. NRCA (WM) - The NRCA Waterproofing Manual; 2005.

## 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for membrane.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.

- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### 1.06 QUALITY ASSURANCE

- A. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### 1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

#### 1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
- C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

### **PART 2 PRODUCTS**

#### 2.01 MEMBRANE MATERIALS

- A. Self-Adhered Modified Bituminous Sheet Membrane:
  - 1. Thickness: 60 mil, 0.060 inch, minimum.
  - 2. Sheet Width: 36 inch, minimum.
  - 3. Tensile Strength:
    - a. Film: 5000 pounds per square inch, minimum, measured according to ASTM D882 and at grip-separation rate of 2 inches per minute.
    - b. Membrane: 325 pounds per square inch, minimum, measured according to ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches per minute.
  - 4. Elongation at Break: 300 percent, minimum, measured according to ASTM D412.
  - 5. Water Vapor Permeance: 0.05 perm, maximum, measured in accordance with ASTM E96/E96M.
  - 6. Low Temperature Flexibility: Unaffected when tested according to ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
  - 7. Peel Strength: 7 pounds per inch, minimum, when tested according to ASTM D903.
  - 8. Lap Adhesion Strength: 5 pounds per inch, minimum, when tested according to ASTM D1876.
  - 9. Puncture Resistance: 50 pounds, minimum, measured in accordance with ASTM E154/E154M.
  - 10. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
  - 11. Hydrostatic Resistance: Resists the weight of 200 feet when tested according to ASTM D5385/D5385M.
  - 12. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.

13. Manufacturers:
    - a. Carlisle Coatings & Waterproofing Inc; MiraDRI 860/861: [www.carlisleccw.com/#sle](http://www.carlisleccw.com/#sle).
    - b. GCP Applied Technologies; Bituthene: [www.gcpat.com](http://www.gcpat.com).
    - c. Henry Company; Blueskin WP 200: [www.henry.com/#sle](http://www.henry.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  - B. Self-Adhered HDPE Sheet Membrane: Recommended by manufacturer for placement below concrete slabs and on outside face of below grade walls before placement of concrete.
    1. Sheet Thickness: 46 mil (0.046 inch), minimum.
    2. Low Temperature Flexibility: Unaffected when tested according to ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
    3. Hydrostatic Resistance: Resists the weight of 231 feet when tested according to ASTM D5385/D5385M.
    4. Elongation at Break: 500 percent, minimum, measured according to ASTM D412.
    5. Tensile Strength, Film: 3,500 pounds per square inch, minimum, measured according to ASTM D412.
    6. Lap Peel Adhesion: 5 pounds per inch, minimum, when tested according to ASTM D1876.
    7. Water Vapor Permeance: 0.01 perm, maximum, measured in accordance with ASTM E96/E96M.
    8. Bond to Concrete: 5 pounds per inch, minimum, per ASTM D903.
    9. Lateral Water Migration Resistance: Resists the weight of 231 feet when tested according to ASTM D5385/D5385M.
    10. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
    11. Manufacturers:
      - a. GCP Applied Technologies; Preprufe 300R: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
      - b. Substitutions: See Section 01 6000 - Product Requirements.
  - C. Seaming Materials: As recommended by membrane manufacturer.
  - D. Membrane Sealant: As recommended by membrane manufacturer.
- ## 2.02 ACCESSORIES
- A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
  - B. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
  - C. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
    1. Composition: Dimpled polystyrene core; polypropylene filter fabric.
    2. Products:
      - a. Epro Services, Inc; ECODRAIN-MS: [www.eproserv.com/#sle](http://www.eproserv.com/#sle).
      - b. Mar-flex Waterproofing & Building Products; ArmorDrain 150: [www.mar-flex.com/#sle](http://www.mar-flex.com/#sle).
      - c. Mar-flex Waterproofing & Building Products; ArmorDrain 400 Protection/Drainage Board: [www.mar-flex.com/#sle](http://www.mar-flex.com/#sle).
  - D. Flexible Flashings: Type recommended by membrane manufacturer.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify items that penetrate surfaces to receive waterproofing are securely installed.

#### **3.02 PREPARATION**

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Prepare building expansion joints at locations as indicated on drawings.
- G. Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

#### **3.03 INSTALLATION - MEMBRANE**

- A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- B. Roll out membrane, and minimize wrinkles and bubbles.
- C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
- D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.
- E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
- G. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- H. Seal membrane and flashings to adjoining surfaces.

#### **3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD**

- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.
- B. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.
- C. Adhere protection board to substrate with compatible adhesive.

#### **3.05 PROTECTION**

- A. Do not permit traffic over unprotected or uncovered membrane.

**END OF SECTION**



**SECTION 07 2100**  
**THERMAL INSULATION**

**PART 1 GENERAL**

## 1.01 SECTION INCLUDES

- A. Board insulation at perimeter foundation wall.
- B. Batt insulation in exterior wall construction.
- C. Acoustical insulation in interior acoustically rated partitions.
- D. Fire safing insulation at fire partitions and perimeter firestopping at curtain walls.

## 1.02 RELATED REQUIREMENTS

- A. Section 07 2119 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.
- B. Section 07 5300 - Elastomeric Membrane Roofing: Insulation specified as part of roofing system.

## 1.03 REFERENCE STANDARDS

- A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2016.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.

## 1.04 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- B. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

## 1.05 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); [www.airbarrier.org/#sle](http://www.airbarrier.org/#sle):
  - 1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.

2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

#### 1.06 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

### **PART 2 PRODUCTS**

#### 2.01 APPLICATIONS

- A. Insulation types are:
  1. Type 1 - Batt/blanket insulation - unfaced.
  2. Type 2 - Batt/blanket insulation with vapor barrier.
  3. Type 3 - Perimeter insulation - rigid.
  4. Type 4 - Cavity wall insulation - rigid.
  5. Type 5 - Acoustical insulation.
  6. Type 6 - Fire safing insulation.
  7. Type 7 - Spray polyurethane foam insulation.
- B. Insulation Type 3 at Perimeter of Foundation: Extruded polystyrene board.
- C. Insulation Type 7 inside Masonry Cavity Walls: Spray Polyurethane Foam, Refer to Section 07 2640.
- D. Insulation Type 7 over sheathing and metal stud framed walls, continuous: Spray Polyurethane Foam, Refer to Section 07 2640.
- E. Insulation Type 1 in Metal Framed Walls: Batt insulation with no vapor retarder.
- F. Insulation Over Roof Deck: Polyisocyanurate board. Refer to Sections 07 5300 and 07 5400.
- G. Acoustical Insulation Type 5 in sound rated partitions.
- H. Fire safing insulation Type 6 at voids and penetrations of fire separations and smoke walls.
  1. For terminations of rated CMU partitions to deck above.
- I. Ventilated composite roof insulation.
  1. Refer to Section 07 3113. For asphalt shingle steep sloped roofs.
  2. Refer to Section 07 6100. For sheet metal roofs.

#### 2.02 FOAM BOARD INSULATION MATERIALS

- A. Type 3 and Type 4: Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
  1. Type: ASTM C578, Type VI.
  2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
  3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
  4. R-value; 1 inch of material at 72 degrees F: 5, minimum.
  5. Board Edges: Square.
  6. Water Absorption, Maximum: 0.3 percent, by volume.

#### 2.03 FIBER BOARD INSULATION MATERIALS

- A. Mineral Fiber Board Insulation Type 6: Rigid or semi-rigid mineral fiber, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
  1. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
  2. Manufacturers:

- a. ROXUL, Inc; CURTAINROCK 80: [www.roxul.com/#sle](http://www.roxul.com/#sle).
- b. ROXUL, Inc; CURTAINROCK 40: [www.roxul.com/#sle](http://www.roxul.com/#sle).
- c. ROXUL, Inc; ROXUL SAFE 65: [www.roxul.com/#sle](http://www.roxul.com/#sle).

#### 2.04 BATT INSULATION MATERIALS

- A. Type 1 and Type 5 Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
  1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
  2. Manufacturers:
    - a. Johns Manville; MinWool Sound Attenuation Fire Batts: [www.jm.com/#sle](http://www.jm.com/#sle).
    - b. Thermafiber, Inc; SAFB: [www.thermafiber.com/#sle](http://www.thermafiber.com/#sle).
    - c. ROXUL, Inc; ROXUL AFB: [www.roxul.com/#sle](http://www.roxul.com/#sle).

#### 2.05 ACCESSORIES

- A. Insulation Fasteners: Impaling clip of nylon with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- B. Adhesive: Type recommended by insulation manufacturer for application.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of irregularities or materials or substances that may impede adhesive bond.

#### 3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Install boards vertically and/or horizontally on foundation perimeter as shown.
  1. Place boards to maximize adhesive contact.
  2. Install in running bond pattern.
  3. Butt edges and ends tightly to adjacent boards and to protrusions.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

#### 3.03 BOARD INSTALLATION AT CAVITY WALLS

- A. Install boards horizontally on walls.
  1. Place boards to maximize adhesive contact.
  2. Butt edges and ends tightly to adjacent boards and to protrusions.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

#### 3.04 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

#### 3.05 FIELD QUALITY CONTROL

- A. Coordination of Air Barrier Association of America (ABAA) Tests and Inspections:

1. Provide testing and inspection required by ABAA Quality Assurance Program (QAP).
2. Notify in ABAA writing of schedule for air barrier work, and allow adequate time for testing and inspection.
3. Cooperate with ABAA testing agency.
4. Allow access to air barrier work areas and staging.
5. Do not cover air barrier work until tested, inspected, and accepted.

3.06 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION**

**SECTION 07 2616****UNDER-SLAB VAPOR BARRIER/RETARDER****PART 1 - GENERAL**

## 1.01 SECTION INCLUDES

- A. Vapor Barrier, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.

## 1.02 RELATED SECTIONS

- A. Section 03 3000 Cast-in-Place Concrete

## 1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM E 1745-97(2004) Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
  - 2. ASTM E 154-99(2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
  - 3. ASTM E 96-05 Standard Test Methods for Water Vapor Transmission of Materials
  - 4. ASTM E 1643-98(2005) Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

## 1.04 SUBMITTALS

- A. Quality Control / Assurance
  - 1. Independent laboratory test results showing compliance with ASTM & ACI Standards.
  - 2. Manufacturer's samples, literature
  - 3. Manufacturer's installation instructions for placement, seaming and pipe boot installation

**PART 2 - PRODUCTS**

## 2.01 MATERIALS

- A. Vapor Barrier
  - 1. Vapor Barrier must have the following qualities
    - a. Perm rating less than or equal to 0.01 perms (grains/(ft<sup>2</sup> \*hr \* in. Hg)) after conditioning as tested by:
      - 1) ASTM E 96
      - 2) ASTM E 1745 Class A (Plastics), paragraph 7.1.2-5.
- B. Vapor Barrier Products: 15 mil plastic sheet - single ply vapor barrier.
  - 1. Stego Wrap (15 mil) Vapor Barrier by STEGO INDUSTRIES LLC, San Clemente, CA (877) 464-7834 [www.stegoindustries.com](http://www.stegoindustries.com)
  - 2. Griffolyn 15 mil Green Vapor Barrier by Reef Industries, Inc.
  - 3. VaporBlock 15 by Raven Industries, Inc.
  - 4. ACCESSORIES
    - a. Seam Tape
      - 1) Tape must have the following qualities:
        - (a) Water Vapor Transmission Rate ASTM E 96: 0.3 perms or lower
    - b. Vapor Proofing Mastic
      - 1) Mastic must have the following qualities:
        - (a) Water Vapor Transmission Rate ASTM E 96: 0.3 perms or lower
    - c. Pipe Boots

- 1) Provide manufacturer's supplied pipe boot system or construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Ensure that subsoil is approved by architect or geotechnical firm
  1. Level and tamp or roll aggregate, sand or tamped earth base.

#### **3.02 INSTALLATION**

- A. Install Vapor Barrier/Retarder:
  1. Installation shall be in accordance with manufacturer's instructions and ASTM E 1643.
- B. Unroll Vapor Barrier/Retarder with the longest dimension parallel with the direction of the pour.
- C. Lap Vapor Barrier/Retarder over footings and seal to foundation walls.
- D. Overlap joints 6 inches and seal with manufacturer's tape.
- E. Seal all penetrations (including pipes) per manufacturer's instructions.
- F. No penetration of the Vapor Barrier/Retarder is allowed except for reinforcing steel and permanent utilities.
- G. Repair damaged areas by cutting patches of Vapor Barrier/Retarder, overlapping damaged area 6 inches and taping all four sides with tape.

**END OF SECTION**

**SECTION 07 9200  
JOINT SEALANTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 1300 - Sheet Waterproofing: Sealing cracks and joints in waterproofing substrate surfaces using materials specified in this section.
- B. Section 07 2500 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.
- C. Section 07 8400 - Firestopping: Firestopping sealants.
- D. Section 08 7100 - Door Hardware: Setting exterior door thresholds in sealant.
- E. Section 08 8000 - Glazing: Glazing sealants and accessories.
- F. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- G. Section 09 2216 - Non-Structural Metal Framing: Sealing between framing and adjacent construction in acoustical and sound-rated walls and ceilings.
- H. Section 09 3000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

**1.03 REFERENCE STANDARDS**

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2006 (Reapproved 2011).
- B. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).
- G. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.
- H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).
- I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.

**1.04 SUBMITTALS**

- A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
  - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
  - 2. List of backing materials approved for use with the specific product.

3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
4. Substrates the product should not be used on.
- B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- D. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- E. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
- F. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- G. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
- H. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
  1. Identification of testing agency.
  2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
    - a. Test date.
    - b. Copy of test method documents.
    - c. Age of sealant upon date of testing.
    - d. Test results, modeled after the sample form in the test method document.
    - e. Indicate use of photographic record of test.
- E. Field Quality Control Plan:
  1. Visual inspection of entire length of sealant joints.
  2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
  3. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.

- a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per floor on each elevation.
  - b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
4. Field testing agency's qualifications.
  5. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
- F. Field Adhesion Test Procedures:
1. Allow sealants to fully cure as recommended by manufacturer before testing.
  2. Have a copy of the test method document available during tests.
  3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
  4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
  5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
  6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- G. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
- H. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inch long.
  2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
  3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

## 1.06 WARRANTY

- A. Correct defective work within a five year period after Date of Substantial Completion.
- B. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

## PART 2 PRODUCTS

### 2.01 JOINT SEALANT APPLICATIONS

- A. Scope:
  1. Exterior Joints: Seal open joints, whether or not the joint is indicated on the drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
    - a. Wall expansion and control joints.
    - b. Joints between door, window, and other frames and adjacent construction.
    - c. Joints between different exposed materials.

- d. Openings below ledge angles in masonry.
- e. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
  - a. Joints between door, window, and other frames and adjacent construction.
  - b. Joints between plumbing fixtures and adjacent construction.
3. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
4. Do not seal the following types of joints.
  - a. Intentional weepholes in masonry.
  - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
  - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
  - d. Joints where installation of sealant is specified in another section.
  - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use non-sag non-staining silicone or polyurethane sealant, Type 1, unless otherwise indicated.
- C. Interior Joints: Use non-sag acrylic latex sealant, Type 2, unless otherwise indicated.
  1. Interior Expansion and Control Joints: Polyurethane sealant; Type 1A.
  2. Fire-rated Construction: ASTM C 834, UL Listed.
  3. In Sound-Rated Assemblies: Acoustical sealant; Type 5.
  4. Interior Wet Areas: Type 6 - Mildew-Resistant Silicone Sealant: not expected to withstand continuous water immersion or traffic. Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

## 2.02 JOINT SEALANTS - GENERAL

- A. Sealant Types Summary:
  1. Type 1: Non-Staining Silicone.
  2. Type 1A: Polyurethane.
  3. Type 2: Acrylic Emulsion Latex
  4. Type 3: Non-Curing Butyl Sealant
  5. Type 4: Fire resistant foam sealant: Refer to Section 07 8400 - Firestopping.
  6. Type 5: Acoustical Sealant
  7. Type 6: Mildew-Resistant Silicone Sealant

## 2.03 NONSAG JOINT SEALANTS

- A. Type 1 - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
  1. Movement Capability: Plus and minus 50 percent, minimum.
  2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
  3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
  4. Color: To be selected by Architect from manufacturer's standard range.
  5. Cure Type: Single-component, neutral moisture curing.
  6. Service Temperature Range: Minus 65 to 180 degrees F.

7. Manufacturers:
  - a. Dow Corning Corporation; 795 Silicone Building Sealant: [www.dowcorning.com/construction/sle](http://www.dowcorning.com/construction/sle).
  - b. Sika Corporation; Sikasil WS-295: [www.usa-sika.com](http://www.usa-sika.com).
  - c. Pecora Corporation; 890NST: [www.pecora.com](http://www.pecora.com).
  - d. Substitutions: See Section 01 6000 - Product Requirements.
- B. Type 1A - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
  1. Movement Capability: Plus and minus 25 percent, minimum.
  2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
  3. Color: To be selected by Architect from manufacturer's standard range.
  4. Service Temperature Range: Minus 40 to 180 degrees F.
  5. Manufacturers:
    - a. Pecora Corporation; DynaTrol 1-XL: [www.pecora.com](http://www.pecora.com).
    - b. Sika Corporation; Sikaflex-15 LM: [www.usa-sika.com](http://www.usa-sika.com).
    - c. Tremco Commercial Sealants & Waterproofing; Dymonic 100: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- C. Type 2 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
- D. Type 3 - Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.
- E. Type 4: Fire resistant foam sealant: Refer to Section 07 8400 - Firestopping.
- F. Type 5 - Acoustical Sealant for Concealed Locations: ASTM C 834, UL Listed.
  1. Composition: Acrylic latex emulsion sealant.
  2. Applications: Use for concealed locations only:
    - a. Acoustical application: Sealant bead between top stud runner and structure and between bottom stud track and floor.
  3. Products:
    - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant: [www.pecora.com](http://www.pecora.com).
    - b. Hilti, Inc.; CP 506 Smoke and Acoustical Sealant: [www.us.hilti.com](http://www.us.hilti.com).
    - c. USG Company; Sheetrock Brand Acoustical Sealant; [www.usg.com](http://www.usg.com).
- G. Type 6 - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
  1. Color: White.
  2. Manufacturers:
    - a. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - b. Sika Corporation; Sikasil GP: [www.usa-sika.com](http://www.usa-sika.com).

#### 2.04 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
  1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.

2. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
3. Manufacturers:
  - a. Nomaco, Inc; SOF Rod: [www.nomaco.com](http://www.nomaco.com).
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
  1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
  2. Notify Architect of date and time that tests will be performed, at least 7 days in advance.
  3. Record each test on Preinstallation Adhesion Test Log as indicated.
  4. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
  5. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

#### **3.02 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

#### **3.03 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
  1. Width/depth ratio of 2:1.
  2. Neck dimension no greater than 1/3 of the joint width.
  3. Surface bond area on each side not less than 75 percent of joint width.
- E. Install bond breaker backing tape where backer rod cannot be used.

- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

#### 3.04 FIELD QUALITY CONTROL

- A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
- C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.
- D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- E. Repair destructive test location damage immediately after evaluation and recording of results.

#### 3.05 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at the low temperature in the thermal cycle. Report failures immediately and repair.

**END OF SECTION**

## **SECTION 22 11 13**

### **FACILITY WATER DISTRIBUTION PIPING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Artesian Water Company (ARTW) Standard Specifications.

##### **1.2 SUMMARY**

- A. This Section includes water-distribution piping and related components outside the building for water service, fire-service mains and combined water service and fire-service mains.

##### **1.3 SUBMITTALS**

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

##### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Comply with requirements of ARTW. Include tapping of water mains and backflow prevention.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

##### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.
  - 2. Protect valves against damage to threaded ends and flange faces.
  - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- 1.6 PROJECT CONDITIONS
1. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner.

## 1.7 COORDINATION

- A. Coordinate connection to water main with owner/ARTW.

## PART 2 - PRODUCTS

### 2.1 WATER PIPING

- A. All water piping and joints shall be as shown on the plans and in accordance with the ARTW Standard Specifications.

### 2.2 GATE VALVES

- A. All gates are in accordance with the ARTW Standard Specifications.

### 2.3 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies are in accordance with the ARTW Standard Specifications.
- a. Valve Boxes are in accordance with the ARTW Standard Specifications.

2.4 FIRE HYDRANTS

- A. All fire hydrants shall be in accordance with ARTW Standard Specifications.

2.5 FIRE DEPARTMENT CONNECTIONS

- A. Fire Department Connections shall be shown on the plans and in accordance with the ARTW Standard Specifications.:

**PART 3 - EXECUTION**

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Water-Main Connection shall be in accordance with the ARTW Standard Specifications.

3.3 JOINT CONSTRUCTION

- A. Make pipe joints in accordance with the ARTW Standard Specifications.

3.4 VALVE INSTALLATION

- A. Install valves in accordance with the ARTW Standard Specifications.

3.5 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position in accordance with the ARTW Standard Specifications..

3.6 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install in accordance with manufacture's recommendations and as shown on the plans..
- B. Install protective pipe bollards on two sides of each fire department connection. Pipe bollards are in accordance with the State of Delaware Fire Marshal requirements.

### 3.7 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water-distribution piping to existing water main as shown on the plans.

### 3.8 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water. Test in accordance with the ARTW Standard Specifications.

### 3.9 IDENTIFICATION

- A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

### 3.10 CLEANING

- A. Clean and disinfect water-distribution piping in accordance with the ARTW Standard Specifications.

END OF SECTION 22 11 13

## **SECTION 22 13 13**

### **FACILITY SANITARY SEWERS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

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

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Pipe and fittings.
  - 2. Nonpressure and pressure couplings.
  - 3. Cleanouts.
  - 4. Encasement for piping.
  - 5. Manholes.
  - 6. Grease Traps
- B. New Castle County Department of Special Services (NCC) Standard Specifications.

##### **1.3 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Pipe and Fittings.
  - 2. Cleanouts.
  - 3. Manholes.
  - 4. Pump Station.
- B. Shop Drawings: For manholes and pump station. Include plans, elevations, sections, details, and frames and covers.

##### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store plastic pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

- C. Handle manholes and grease trap according to manufacturer's written rigging instructions.

## 1.5 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
  - 2. Contractor must limit disruption of service to no more than four (4) hours.

## PART 2 - PRODUCTS

### 2.1 SANITARY SEWER PIPING AND FITTINGS

- A. All sanitary sewer pipe and fittings shall be as shown on the plans and in accordance with the NCC Standard Specifications.

### 2.2 CLEANOUTS

- A. PVC Cleanouts:
  - 1. All cleanouts shall be as shown on the plans and in accordance with the NCC Standard Specifications.

### 2.3 MANHOLES

- A. Standard Precast Concrete Manholes:
  - 1. Sanitary sewer manholes are as shown on the plans and in accordance with the NCC Standard Specifications.
- B. Manhole Frames and Covers:
  - 1. As shown on the plans and in accordance with the NCC Standard Specifications
- C. Pump Station:
  - 1. As shown on the plans and in accordance with the NCC Standard Specifications

**PART 3 - EXECUTION****3.1 EARTHWORK**

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

**3.2 PIPING INSTALLATION**

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

**3.3 PIPE JOINT CONSTRUCTION**

- A. Join gravity-flow, non-pressure, drainage piping according to the manufacture's recommendations.

**3.4 MANHOLE INSTALLATION**

- A. General: Install manholes complete with appurtenances and accessories indicated in accordance with manufacture's recommendations.

**3.5 CLEANOUT INSTALLATION**

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. .
  - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
  - 2. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
- B. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

### 3.6 CONNECTIONS

- A. Connect non-pressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping and underground manholes.
  - 1. Make branch connections from side into existing piping to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through r structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
    - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
  - 2. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

### 3.7 PUMP STATION

- A. Construct Pump Station in accordance with the plans and the NCC Standard Specifications.

### 3.8 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

### 3.9 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate report for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

- c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
  - d. Infiltration: Water leakage into piping.
  - e. Exfiltration: Water leakage from or around piping.
- 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Re-inspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects in accordance with KCPW Standard Specifications..

### 3.10 CLEANING

- A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 22 13 13

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## **SECTION 31 10 00**

### **SITE CLEARING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

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

##### **1.2 SUMMARY**

- A. Section Includes:

- 1. Protecting existing vegetation to remain.
- 2. Removing existing vegetation.
- 3. Clearing and grubbing.
- 4. Stripping and stockpiling topsoil.
- 5. Removing above- and below-grade site improvements.
- 6. Disconnecting, capping or sealing, and removing site utilities.
- 7. Temporary erosion- and sedimentation-control measures.

- B. Related Sections:

- 1. Division 01 Section "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities.
- 2. Division 01 Section "Execution" for field engineering and surveying.
- 3. Division 01 Section(s) "Construction Waste Management and Disposal and "Sustainable Design Requirements" for additional LEED requirements.
- 4. Division 02 Section "Structure Demolition" for demolition of buildings, structures, and site improvements.
- 5. Division 02 Section "Selective Structure Demolition" for partial demolition of buildings or structures.

- C. Delaware Department of Transportation (DelDOT) Standard Specifications.

- D. Delaware Department of Natural Resources and Environmental Control (DNREC) Erosion and Sediment Control Handbook.

### 1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction
- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

### 1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain on Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

### 1.5 SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
  - 1. Use sufficiently detailed photographs or videotape.
  - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

### 1.6 QUALITY ASSURANCE

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

## 1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.
- C. Utility Locator Service: Notify Miss Utility (1-800-282-8555) for area where Project is located 72-hours before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving" and the project Soils Report

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain.
- C. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

### 3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings in accordance with the DNREC Erosion and Sediment Control Handbook.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal upon approval of DNREC and the owner.

### 3.3 TREE AND PLANT PROTECTION

- A. General: Protect trees and plants remaining on-site according to requirements in Division 01 Section "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

### 3.4 EXISTING UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
  - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
  - 1. Arrange with utility companies to shut off indicated utilities.
  - 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Architect's written permission.

- E. Excavate for and remove underground utilities indicated to be removed.

### 3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
  - 3. Use only hand methods for grubbing within protection zones.
  - 4. Removed tree branches to be disposed off-site by the contractor.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
  - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

### 3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to the depth found in the Geo-technical Report in a manner to prevent intermingling with underlying subsoil or other waste materials.
  - 1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Stabilize stockpiles in accordance with the DNREC Erosion and Sediment Control Handbook.
  - 1. Limit height of topsoil stockpiles to 10 feet.
  - 2. Do not stockpile topsoil within protection zones.
  - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

### 3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

### 3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 10 00

**SECTION 31 20 00****EARTH MOVING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY****A. Section Includes:**

1. Preparing subgrades for all aspects of construction shown on the plans.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.
8. Excavating well hole to accommodate elevator-cylinder assembly.
9. Warning Tracks
10. Pitching Mounds

**B. Related Sections:**

1. Division 01 Section "Construction Progress Documentation" for recording pre-excavation and earth moving progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
3. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Division 14 Section "Hydraulic Elevators" and "Hydraulic Freight Elevators" for excavating well hole to accommodate elevator-cylinder assembly.
5. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
6. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

7. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.
  8. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
  9. Division 31 Section "Drilled Concrete Piers and Shafts" for excavation of shafts and disposal of surplus excavated material.
  10. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
  11. Division 32 Section "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.
  12. Division 33 Section "Sub-drainage".
- C. Delaware Department of Transportation (DelDOT) Standard Specifications.
- D. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.

### 1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
- G. Fill: Soil materials used to raise existing grades.

### 1.4 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
1. Geotextiles.
  2. Controlled low-strength material, including design mixture.

## 1.5 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- B. Pre-excavation Conference: Conduct conference at Project site.

## 1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify Miss Utility (1-800-282-8555) for area where Project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 31 Section "Site Clearing are in place.

## **PART 2 - PRODUCTS**

### 2.1 SOIL MATERIALS

- 1. All on-site borrow, subbase material, base course and drainage course shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

### 2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters meeting Mirafi 140N or approved equal.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters meeting Mirafi 600X or approved equal.

### 2.3 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.
6. Green: Sewer systems. Porous Fill Under Infields: Use AASHTO #57, well consolidated, under all skinned areas. (ALTERNATE?)

## 2.4 ATHLETIC FIELDS

A. Pea Gravel Choke Layer: Use a washed uniform pea gravel, maximum 3/8" size, as choke/separator layer between crushed aggregate base and all skinned infield areas, as detailed.

B. "Skinned" Infield Mix – At all infield areas, provide 4 -1/2" "Martins Infield Mix", Martins Quarry, Bechtelsville, PA (610) 367-2011, or approved equal as Diamond Tex, etc. Submit samples for approval by Owner and Architect.

C. Warning Track – Provide 4" manufacturer's mix specifically blended for this use, as detailed. Submit samples for approval by Owner and Architect.

D. Clay Mix for Pitching Mounds and Batter's Box Area – Use bag clay specifically formulated for this use in high-wear forward area of mound, and at batter's box area, placed as top 4" of material, and covering the forward 30% of the mound, as well as entire batter's box area. Submit samples for approval by Owner and Architect.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

### 3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

### 3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

### 3.4 EXCAVATION, GENERAL

- A. All excavation shall be as shown on the plans and in accordance with the DeIDOT Standard Specifications and the DNREC Sediment and Erosion Control Handbook.

### 3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
  - 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
  - 2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

### 3.6 EXCAVATION FOR WALKS AND PAVEMENTS

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

### 3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
  - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
  - 1. Clearance: 12 inches **each** side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

### 3.8 SUBGRADE INSPECTION

- A. Notify Architect/Engineer/Construction Manager when excavations have reached required subgrade.
- B. If Architect/Engineer/Construction Manager determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
  - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

### 3.9 UNAUTHORIZED EXCAVATION

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

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

### 3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.11 BACKFILL

- A. Place and compact backfill in excavations promptly as shown on the plans and in accordance with the DeIDOT Specifications.

### 3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section Cast-in-Place Concrete.
- D. Backfill voids with satisfactory soil while removing shoring and bracing.
- E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

### 3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
  1. Under grass and planted areas, use satisfactory soil material.
  2. Under walks and pavements, use satisfactory soil material.
  3. Under steps and ramps, use engineered fill.
  4. Under building slabs, use engineered fill.

5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

### 3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place and compact fill as shown on the plans and in accordance with the DeIDOT Standard Specifications.

### 3.16 GRADING

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

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

### 3.17 SUBSURFACE DRAINAGE

A. Sub-drainage Pipe: Specified in Division 33 Section "Sub-drainage."

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade.

### 3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place as shown on the plans and in accordance with the DeIDOT Standard Specifications.

## 3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

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

## 3.20 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
  - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft or less of paved area or building slab, but in no case fewer than three tests.
  - 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; re-compact and retest until specified compaction is obtained.

## 3.21 INFIELD “SKINNED AREAS”

- A. Rough and finish grade the field, establishing precision grade at base lines and corners, and pitcher’s mound. Subgrade shall be 10” below finished grade of skinned area, except for pitching mound, which shall be 6” below finished grade. Trim edges of excavated subgrade with vertical faces.

- B. Finish grade a 4-1/2” thickness of the mix, spread uniformly over the rough grade and compacted to a 4” thickness with a light power roller. Cover rolled mixture with a 1/2” thick layer of the mix, and roll lightly, then rake to a uniformly smooth surface, removing all stones.
- C. Finish grade of skinned area shall be completely flush with surrounding topsoiled areas, so as to show no change in grade at the juncture of these areas.
- D. Repair all low spots, depressions, wash-outs within 30 days of installation to Owner’s satisfaction.

### 3.22 WARNING TRACKS

- A. Strip topsoil and excavate 4” for track area, per plan. Track shall be 15 Feet wide. Extend track 1’ beyond line of chain link fence as shown. Slope subgrade at 2.0% toward fence.
- B. Trim edges of excavated soil with clean, vertical faces.
- C. Provide the warning track material, spread evenly and compacted.
- D. Repair all low spots, depressions, wash-outs within 30 days of installation to Owner’s satisfaction.

### 3.23 PITCHING MOUNDS

- A. Construct with clay base soil material, shaping and compacting. Utilize manufactured clay for top 3” at forward portion of mound (pitchers landing area), as detailed. Construct top 3” of batter’s box with equal clay material. (12’ wide x 16’ deep, encompassing batters box and catcher’s area)

### 3.24 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
  - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and re-compact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

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

### **3.25 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
  1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

## **SECTION 31 23 19**

### **DEWATERING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

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

##### **1.2 SUMMARY**

- A. Section includes construction dewatering.
- B. Related Sections:
  - 1. Division 01 Section "Construction Progress Documentation" for recording preexisting conditions and dewatering system progress.
  - 2. Division 31 Section "Earth Moving" for excavating, backfilling, site grading, and for site utilities.
  - 3. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
  - 4. Division 33 Section "Sub-drainage" for permanent foundation wall, underfloor, and footing drainage.
- C. Delaware Department of Transportation (DelDOT) Standard Specifications.
- D. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.

##### **1.3 PERFORMANCE REQUIREMENTS**

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
  - 1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

#### 1.4 SUBMITTALS

- A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
  1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
  2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.
- B. Field quality-control reports.
- C. Other Informational Submittals:

#### 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with DNREC notification regulations before beginning dewatering. Comply with hauling and disposal regulations of the DNREC Sediment and Erosion Control handbook

#### 1.6 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  1. Notify Owner no fewer than two days in advance of proposed interruption of utility.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
  2. The geotechnical report is included in the Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

## PART 2 - **PRODUCTS** (Not Used)

## PART 3 - **EXECUTION**

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
  2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Monitor dewatering systems continuously.
- E. Promptly repair damages to adjacent facilities caused by dewatering.
- F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing during dewatering operations."

### 3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
  - 1. Space well points or wells at intervals required to provide sufficient dewatering.
  - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
  - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- E. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
  - 1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.
- F. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

### 3.3 FIELD QUALITY CONTROL

- A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
  2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
  3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 31 23 19

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## SECTION 316219 - TIMBER PILES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes round timber piles.

## 1.2 UNIT PRICES

- A. Contract Sum: Base Contract Sum on number and dimensions of piles indicated from tip to cutoff, plus not less than 12 inches (305 mm) of overlength for cutting piles at cutoff elevations.
  - 1. Provide 25-ton, 12 inch diameter timber piles as per the length recommended in the geotechnical report by Duffield & Associates.
- B. Work of this Section is affected as follows:
  - 1. Additional payment for pile lengths in excess of that indicated, and credit for pile lengths less than that indicated, is calculated at unit prices stated in the Contract, based on net addition or deduction to total pile length as determined by Architect and measured to nearest 12 inches (305 mm).
    - a. Additional payment for splices required to extend pile lengths in excess of that indicated is calculated at unit prices stated in the Contract.
  - 2. Additional payment for number of piles in excess of that indicated, and credit for number of piles less than that indicated, is calculated at unit prices stated in the Contract.
  - 3. Unit prices include labor, materials, tools, equipment, and incidentals for furnishing, driving, cutting off, capping, and disposing of cutoffs.
  - 4. Test piles that become part of permanent foundation system are considered as an integral part of the Work.
  - 5. No payment is made for rejected piles, including piles driven out of tolerance, defective piles, or piles damaged during handling or driving.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For timber piles. Show fabrication and installation details for piles, including details of driving shoes, tips or boots, and pile butt protection.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Round timber pile treatment data.
- B. Pile-Driving Equipment Data: Include type, make, and rated energy range; weight of striking part of hammer; weight of drive cap; and, type, size, and properties of hammer cushion.
- C. Pile-driving records.
- D. Field quality-control reports.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store piles at Project site to prevent breaks, cuts, abrasions, or other physical damage and as required by AWPA M4. Do not drill holes or drive spikes or nails into pile below cutoff elevation.

## PART 2 - PRODUCTS

### 2.1 TIMBER PILES

- A. Round Timber Piles: ASTM D 25, unused, clean peeled, one piece from butt to tip; of the following species and size basis:
  - 1. Manufacturers: Subject to compliance with requirements.
  - 2. Species: Coastal Douglas fir or Southern yellow pine.
  - 3. Size Basis: Butt circumference Class B.
- B. Pressure-treat round timber piles according to AWPA U1 as follows:
  - 1. Service Condition: UC4C Ground Contact, Extreme Duty
  - 2. Treatment: Waterborne preservative, creosote or creosote solution, or oil-borne preservative.

### 2.2 PILE ACCESSORIES

- A. Driving Shoes: Fabricate from ASTM A 1011/A 1011M, hot-rolled carbon-steel strip to suit pile-tip diameter.

### 2.3 FABRICATION

- A. Pile Tips: Cut and shape pile tips to accept driving shoes. Fit and fasten driving shoes to pile tips according to manufacturer's written instructions.

- B. Pile Butt: Trim pile butt and cut perpendicular to longitudinal axis of pile. Chamfer and shape butt to fit tightly to driving cap of hammer.
- C. Field-Applied Wood Preservative: Treat field cuts, holes, and other penetrations according to AWPA M4.
- D. Pile-Length Markings: Mark each pile with horizontal lines at 12-inch (305-mm) intervals; label the distance from pile tip at 60-inch (1524-mm) intervals. Maintain markings on piles until driven.

### PART 3 - EXECUTION

#### 3.1 DRIVING PILES

- A. General: Continuously drive piles to elevations or penetration resistance indicated. Establish and maintain axial alignment of leads and piles before and during driving.
- B. Heaved Piles: Redrive heaved piles to tip elevation at least as deep as original tip elevation with a driving resistance at least as great as original driving resistance.
- C. Driving Tolerances: Drive piles without exceeding the following tolerances, measured at pile heads:
  - 1. Location: 4 inches (102 mm) from location indicated after initial driving, and 6 inches (152 mm) after pile driving is completed.
  - 2. Plumb: Maintain 1 inch (25 mm) in 48 inches (1219 mm) from vertical, or a maximum of 4 inches (102 mm), measured when pile is aboveground in leads.
  - 3. Batter Angle: Maximum 1 inch (25 mm) in 48 inches (1219 mm) from required angle, measured when pile is aboveground in leads.
- D. Withdraw damaged or defective piles and piles that exceed driving tolerances, and install new piles within driving tolerances. Fill holes left by withdrawn piles as directed by Architect.
- E. Cut off butts of driven piles square with pile axis and at elevations indicated.
  - 1. Cover cut-off piling surfaces with minimum three coats of preservative treatment according to AWPA M4.
- F. Pile-Driving Records: Maintain accurate driving records for each pile.

#### 3.2 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Pile foundations.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Tests and Inspections:

1. Dynamic Pile Testing: High-strain dynamic monitoring shall be performed and reported according to ASTM D 4945 during initial driving and during restriking on 3 percent of piles.

END OF SECTION 316219

## **SECTION 32 12 16**

### **ASPHALT PAVING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

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

##### **1.2 SUMMARY**

###### **A. Section Includes:**

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt paving overlay.
5. Pavement-marking paint.

###### **B. Related Sections:**

1. Division 02 Section "Structure Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

###### **C. Delaware Department of Transportation (DelDOT) Standard Specifications.**

###### **D. Delaware Department of Natural Resources and Environmental Control (DNREC) Erosion and Sediment Control Handbook.**

##### **1.3 DEFINITION**

- A. Hot-Mix Asphalt Paving Terminology: See DelDOT Standard Specifications.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
  - 1. Job-Mix Designs: For each job mix proposed for the Work.
- B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Material Certificates: For each paving material, from manufacturer.
- D. Material Test Reports: For each paving material.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by DelDOT.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of DelDOT for asphalt paving work.
  - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.
- D. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
    - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
    - b. Review condition of subgrade and preparatory work.
    - c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
    - d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: See DeIDOT Standard Specifications
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials 55 deg F for water-based materials, and not exceeding 95 deg F.

**PART 2 - PRODUCTS**

2.1 AGGREGATES

- A. General: All aggregates for asphalt paving are in accordance with the DeIDOT Standard Specifications.

2.2 ASPHALT MATERIALS

- A. All asphalt materials are in accordance with the DeIDOT Standard Specifications.
- B.

2.3 AUXILIARY MATERIALS

- A. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
- B. Joint Sealant: Per the DeIDOT Standard Specifications.
- C. Pavement-Marking Paint: As shown on the project plans and in accordance with the DeIDOT Standard Specifications.

2.4 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by DeIDOT and in accordance with the DeIDOT Standard Specifications.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

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

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

### 3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 2 inches.
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Transport milled hot-mix asphalt to asphalt recycling facility.
7. Keep milled pavement surface free of loose material and dust.

### 3.3 PATCHING

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

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving in accordance with the DelDOT Standard Specifications.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

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

### 3.4 SURFACE PREPARATION

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

- B. Prime Coat: In accordance with the DelDOT Standard Specifications.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement in accordance with the DelDOT Standard Specifications.

### 3.5 PAVING GEOTEXTILE INSTALLATION

- A. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.
  - 1. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.

### 3.6 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted in accordance with the DelDOT Standard Specifications.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
  - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.7 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat to joints.
  - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
  - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time.
  - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
  - 6. Compact asphalt at joints to a density within 2 percent of specified course density.

### 3.8 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers in accordance with the DeIDOT Standard Specifications.
- B. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- C. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- D. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.9 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the tolerances found in the DeIDOT Standard Specifications.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the tolerances found in the DeIDOT Standard Specifications.

### 3.10 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for 14 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
  - 1. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- C. In-Place Density: In accordance with the DeIDOT Standard Specifications.

3.12 DISPOSAL

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

END OF SECTION 32 12 16

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**SECTION 32 13 13**  
**CONCRETE PAVING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Walks.
- 2. Concrete Pavement
- 3. Concrete Pads
- 4. Concrete Curb

B. Related Sections:

- 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
- 2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

C. Delaware Department of Transportation (DelDOT) Standard Specifications.

D. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

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

- B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Other Action Submittals:
  - 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Material Certificates: For the following, from manufacturer:
  - 1. Cementitious materials.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Admixtures.
  - 4. Curing compounds.
  - 5. Applied finish materials.
  - 6. Bonding agent or epoxy adhesive.
  - 7. Joint fillers.
  - 8. Aggregates and sand materials.
- E. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with the DelDOT Standard Specifications.
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
  - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- C. Pre-installation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
    - a. Quality control of concrete materials and concrete paving construction practices.
  - 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
    - a. Contractor's superintendent.

- b. Concrete paving subcontractor.

## 1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

## **PART 2 - PRODUCTS**

### 2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces in accordance with the DeIDOT Standard Specifications.
- B. Form-Release Agent: In accordance with the DeIDOT Standard Specifications

### 2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets as shown on the plans and in accordance with the DeIDOT Specifications.

### 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - a. Portland Cement: Per the DeIDOT Standard Specifications.
- B. Normal-Weight Aggregates: Per the DeIDOT Standard Specifications.
- C. Water: Per the DeIDOT Standard Specifications.
- D. Air-Entraining Admixture: Per the DeIDOT Standard Specifications.

### 2.4 CURING MATERIALS: All curing shall be in accordance with the DeIDOT Standard Specifications.

### 2.5 RELATED MATERIALS

- A. Joint Fillers: In accordance with the DeIDOT Standard Specifications.

## 2.6 CONCRETE MIXTURES

- A. All concrete shall be Type “B” (3,000 PSI) in accordance with the DeIDOT Standard Specifications.

## 2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete in accordance with the DeIDOT Standard Specifications.

# **PART 3 - EXECUTION**

## 3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
  - 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
  - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
  - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

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

## 3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.4 STEEL REINFORCEMENT

- A. General: In accordance with the DeIDOT Standard Specifications.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

### 3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
  - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
  - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
  - 2. Provide tie bars at sides of paving strips where indicated.
  - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
  - 1. Locate expansion joints at intervals of 50 feet for paving and 20 feet for sidewalks and curbing unless otherwise indicated.
  - 2. Extend joint fillers full width and depth of joint.
  - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
  - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness at 25-foot intervals for paving and 5-feet for sidewalks.
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

### 3.6 CONCRETE PLACEMENT

- A. Placement of concrete shall be as shown on the plans and in accordance with the DeIDOT Standard Specifications.

### 3.7 FLOAT FINISHING

- A. Float finishing shall be in accordance with the DeIDOT Standard Specifications.

### 3.8 CONCRETE PROTECTION AND CURING

- A. Concrete protection and curing shall be in accordance with the DeIDOT Standard Specifications.

### 3.9 PAVING TOLERANCES

- A. Paving tolerances shall be in accordance with the DeIDOT Standard Specifications.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  - 1. Testing Frequency: In accordance with the DeIDOT Standard Specifications.
  - 2. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
  - 3. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

- a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Concrete paving will be considered defective if it does not pass tests and inspections.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

**SECTION 32 1814  
SUBGRADE AND STONE AGGREGATE DRAINAGE LAYER**

**PART 1 - GENERAL**

**1.1 RELATED WORK SPECIFIED ELSEWHERE**

- A. General conditions, special conditions, and Section "Scope of Work" are a part of and govern this section.
- B. Excavation and subgrade compaction, see Section 312000, Earth Moving.
- C. Field perimeter curb, see Section 321313, Concrete Paving.
- D. Field Retaining Walls, see Section 321313, Concrete Paving.
- E. Site storm drainage, see Section 334100, Storm Utility Drainage Piping.
- F. Elastomeric layer pad, see Section 321800, Shock Pads.
- G. Pre-fabricated Shock Pad, see section 321800, Shock Pads.

**1.2 SCOPE OF WORK**

- A. Furnish and install a new vertically-drained stone base layer utilizing a stable subgrade, aggregate drainage layer and drainage network.
- B. The design requirements contained in this subsection cover the general minimum considerations in geometric layout and materials. For specific requirements referencing technical testing societies, organizations, associations, etc. see the subsection on Technical Requirements.
- C. The work of this Section includes, but is not necessarily to be limited to:
  - 1. Engineering layout.
  - 2. Erosion and sediment controls.

3. Excavation and grading.
4. Removal of excess earth and topsoil from the site.
5. Construction of a stable subgrade.
6. Construction of the permeable aggregate base layer and underdrain system.
7. Verification of drainage (permeability).
8. Verification of finished surface slope and planarity.
9. Cleanup.
10. Guarantee.
11. Maintenance.

### 1.3 CONTRACTOR QUALIFICATIONS

- A. The Contractor shall have been actively and directly engaged in constructing stadium athletic fields for a period of five (5) years or more, and provide proof of ten (10) or more sports field installations completed by them within the last three (5) years, five of which must be synthetic turf fields.
- B. In addition, the Owner may make such investigations as he deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work specified herein.

### 1.4 WORK BY OTHERS

- A. This Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work and shall properly connect and coordinate his work with theirs.

- B. Where any part of the Contractor's work depends for proper execution or results upon the work of any other separate Contractor, the Contractor shall inspect and promptly report to the Architect any apparent discrepancies or defects in such work that render it unsuitable for such proper execution and results. Failure of the Contractor to inspect and report shall constitute an acceptance of the other Contractor's work as fit and proper to receive his work, except as to defects which may develop in the other separate Contractor's work after the execution of the Contractor's work.
- C. Should the Contractor cause damage to the work or property of any separate Contractor on the project, the Contractor shall, upon due notice, settle with such other Contractor by agreement or arbitration.

#### 1.5 CONDITIONS

- A. All the conditions, shown and/or specified, and the incidental conditions in or about the project site and structure, shall be considered mandatory parts of the Contract Documents.

#### 1.6 SUBCONTRACTORS

- A. The Contractor shall furnish, within five (5) days after notification, a list of subcontractors he proposes to employ in the work. The approval of subcontractors shall be a condition precedent to award of the contract. All subcontractors shall be subject to the approval of the Architect and/or the Owner.

#### 1.8 MATERIAL SAMPLES AND INSPECTIONS

- A. Submit samples of all dry materials and labels of liquids or wettable powders to be used in construction ten (10) days or more before beginning work.

#### 1.9 ENGINEERING LAYOUT

- A. The Contractor shall employ a registered engineer, landscape architect or surveyor to lay out all lines, grades and construction staking. Periodically throughout this

project, the Architect may request the Contractor to verify the required construction elevations.

#### 1.10 SITE PREPARATION - GENERAL

- A. Keep excavation, stored materials, and other areas, free from excess rain or subsurface water at all times.
- B. Excess material excavated, including suitable fill material and topsoil shall be removed.
- C. Any piping, conduits or wiring encountered that are not required to be removed or otherwise encountered shall be temporarily supported and maintained until permanent support has been restored.
- D. Utilize Geotechnical Consultant or Site Engineer for on-site work, inspecting during entire excavation, subgrade stabilization, underdrain system and porous aggregate base layer construction, utilizing a competent Testing Laboratory to evaluate soil conditions and drainage properties. Submit test results, as required, indicating compliance.
- E. Backfill and compact around structures, walls, trenches and where concrete curbs are installed.
- F. Rutting in the subgrade created by offloading and placement of the aggregate material shall be thoroughly repaired, by filling with competent material and compacting and rolling, in accordance with procedures specified herein.
- G. Utilizing laser-guided equipment perform rough and precision grading in areas required, to the lines and grades required for the permeable aggregate base, and in accordance with recommended tolerances.

H. Keep excavations and the remainder of site free from dirt and debris at all times during the progress of the work, and in accordance with other applicable sections of the specifications.

1.11 CONSTRUCTION OF PERMEABLE AGGREGATE BASE LAYER, AND UNDERDRAIN SYSTEM

A. EXCAVATION

1. The site shall be excavated to a depth that the subgrade becomes stable. Topsoil shall be stripped and removed from the site. All other excavated soil shall be removed from the site.
2. When the proper sub-grade elevation is established, the entire area shall be proof-rolled with a ten ton (static weight) smooth-wheeled roller, to delineate localized loose, or soft zones. All such material shall be undercut to competent material.
3. The Site/Geotechnical Engineer will determine whether the materials in the excavated areas are suitable for use as backfill. All unsuitable material shall be removed and all new materials shall be approved before use.
4. The sub-grade shall be constructed using the approved backfill material.

This material shall be placed in lifts not greater than 6" (15.24 cm) in depth. Each lift (layer) shall be compacted separately. The moisture in the soil, at the time of compaction, shall be uniformly distributed and should be within 90 and 120 percent range of the optimum. Within these limits, the Site Engineer will determine the proper moisture level to be used.
5. The backfill material in the first layer shall be rolled until the course has been uniformly compacted to over 95 percent of the maximum dry density. The second and succeeding courses shall be placed and mixed and then compacted as specified in the first course.

6. The finished surface of the sub-grade shall have a finished grade as shown. Sub-grade shall be established to within the tolerance of +0.0' or -0.02' of the design sub-grade elevation.
7. Excavate collector trenches, width and depth as required for the collector drain plus 6 inches on each side of the pipe. Trenches shall be excavated and sloped for drainage. The trenches shall be excavated with the indicated percent slope starting from the high point of the drainage system extending toward the storm drain connection points.
8. All loose debris shall be removed from the tops, edges and inside trenches. The trenches shall then be compacted by tamping or other approved means to 95 percent of the maximum dry density.

#### B. UNDERDRAIN SYSTEM

##### 1. GEOTEXTILE

Verify that surface elevations of finished sub-grade conform to elevations shown on drawings prior to under drain system construction and that the sub-grade surface is uniform and free of depressions, voids, and irregularities. Provide nonwoven, porous geotextile (DOT Class 1) in accordance with manufacture's written recommendations and DOT Specifications, over the entire field sub-grade. Collector drain trenches shall be lined with non-porous geotextile.

Additionally, overlap joints a minimum of 8". All laps shall be overlapped in the direction the stone aggregate is to be spread. Place a suitable amount of ballast on the fabric to prevent movement by the

wind. Ballast shall be in a form which will not damage fabrics. Direct loading on fabric by traffic will not be permitted. Fabric must completely cover perimeter trenches.

2. FIELD COMPOSITE DRAINS

Install perforated under drain conduits at 16 feet on-center as a 45-degree angle on top of the geotextile, securing to fabric every 10-15 linear feet with duct tape, or other suitable material. These conduits shall be a composite drainage system as J-Drain 12 as manufactured by JDR Enterprises, Inc., (800) 843-7569, or acceptable equivalent. Connect ends of these composite drains into the perimeter collector drain pipe, or otherwise direct downward into 50% of the trench depth.

3. COLLECTOR DRAINS

Place perforated under drain pipes in the collector trenches, size per plan. Centerline of the pipe shall coincide with centerline of trench. The pipes shall be capable of withstanding the anticipated loading without deformation. Pipe meeting ASTM standard F-405 (stiffness at 5 percent deflection if 40 psi (2.8 kg/cm<sup>2</sup>) minimum and the stretch resistance is 10 percent maximum) are suitable for use as under drain. Collector drains must be connected as shown on plans.

- (a) A minimum of 2" of clean, drainable crushed stone aggregate (AASHTO #57) shall be placed in the bottom of the collector trenches, on top of moisture barrier. Compact to 95 percent.
- (b) Place a minimum of 6" of the clean, crushed aggregate on the sides of the under-drain pipes and headers, and 6" minimum of the aggregate on top of the pipe network. Compact suitably.

- (c) Prior to placement of the aggregate layer, verify the planarity of the subgrade to tolerance specified, and remove all “lipping” at both sides of all collector drain trenches, to ensure no impediment of surface flow of water into the trenches.

C. AGGREGATE LAYER

1. A uniformly mixed aggregate shall be placed over the entire sub-base which has been covered with the geotextile filter fabric. The aggregate shall comprise a minimum of 6" of compacted, stable, permeable crushed limestone aggregate. Care shall be taken to maintain the grade designed for the sub-base. The capability of the aggregate drainage layer to meet the stability and permeability requirement must be determined by a certified laboratory or Contractor prior to construction of the course. It is recommended that the aggregate layer be consolidated to a density of 90 percent. A nuclear density gauge should be used during aggregate placement and rolling to ensure adequate compaction.
2. Submit procedure how contractor proposes to for place, level and consolidate the stone aggregate drainage layer, for Owner and Architect approval.
3. Material shall be a minimum of 75 percent fractured with at least one fractured face by mechanical means on each individual particle larger than 1/4". Material shall be clean of mineral fines.
4. Typical aggregate or aggregate blends found acceptable as an aggregate drainage course conform to the following gradation: (DeIDOT NO. 57 Coarse Aggregate may meet the above requirements)

<u>Sieve</u>	<u>Sieve -Metric (mm)</u>	<u>Percent Passing by Weight</u>
1-1/2"	38.1	100
1"	25.4	95 - 100
3/4"	19.0	80 - 100
1/2"	12.7	60 - 80

3/8"	9.52	30 - 50
No. 4	4.75	20 - 40
No. 8	2.38	10 - 30
No. 40	0.42	5 - 17
No. 200	75 mm	1 - 4

**D. PLACEMENT OF PERMEABLE AGGREGATE BASE**

1. Install permeable aggregate base to the lines and grades indicated.
2. The Contractor shall shape the complete surface of the aggregate base to receive the overlying elastomeric layer pad base and continue until the deviation from the required elevation does not exceed a compensating maximum deviation from grade of 1/8" in 10'.
3. The surface of the aggregate base course shall be well drained at all times. The permeability of the aggregate shall be checked by using 10" diameter cylinder and five (5) gallons of water to drain in less than one (1) minute. Test samples shall be taken (at a minimum of) one sample per every 5,000 square feet or as otherwise directed.
4. All test results will be logged and documented by the Contractor or Site Engineer. If, at any time, the aggregate base does not meet specifications, it shall be the Contractor's responsibility to restore, at his expense, the aggregate base to the required grade, cross section, density and permeability.
5. Moisture Content:

Aggregate must contain 3.5 percent to 4.0 percent moisture content to ensure that fines do not migrate and to facilitate proper compaction. This is critical. Contractor shall ensure that aggregate leaving the source plant meets this requirement and is required to apply water to aggregate on site to attain and maintain this minimum moisture content.

6. Placement:

- (a) Prior to aggregate placement, remove any excess or contaminated backfill from the drainage trenches.
- (b) The sub-grade surface must be free of standing water prior to aggregate placement.
- (c) Ruts in the subgrade created by offloading and placement of the aggregate material shall be thoroughly repaired, by filling with competent material and compacting and rolling, in accordance with procedures specified herein.
- (d) The aggregate should be placed in one lift.
- (e) The aggregate layer must be spread uniformly with equipment that will not cause perceptible separation in gradation (segregation of the aggregates), preferably a self-propelled paving machine.
- (f) Should this occur, during any stage of the spreading or stockpiling (a separation of the materials or particles), the contractor must immediately remove and dispose of segregated material and correct or change handling procedures to prevent any further separation.
- (g) The Contractor shall utilize dual-plane laser-guided slope and grade equipment control systems for the grading of the permeable aggregate to ensure accuracy in the grade tolerances.

7. Compaction and Planarity:

- (a) The aggregate layer shall be compacted (consolidated) to a minimum density of 90 percent of maximum dry density, utilizing a static,

tandem drum-type roller, and as determined by ASTM 0698 and measured using a nuclear method, and to where it is stable.

- (b) Proof roll wherever possible and mark “soft spots” for additional compaction. Use static tandem drum-type roller of not less than five (5) tons weight (non-vibratory roller), to consolidate. Excess rolling will produce segregation of fines and shall be avoided.
- (c) The finished surface shall not deviate (tolerance-to-grade) from designated compacted grade. This means that the surface shall not deviate more than 1/8” in 10’ (any direction) when placed under a 10’ long straight edge. This tolerance is required over the entire field.
- (d) Provide survey elevation of finish graded aggregate base layer specified for verification of field slope and planarity, as specified in Section 02535, 3.2 (A).

Areas that deviate should be marked with spray paint and corrected with material and rolled tight. Such remedial actions should be done by hand.

- 8. Contractor shall provide written certification that the sub-grade and aggregate base has been properly constructed, tested for drainage, slope and planarity, and meet the requirements of the specifications.

-- END --

## SECTION 32 31 13

### CHAIN LINK FENCES AND GATES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Chain-link fences and gates.
- 2. Swing Gates

- B. Related Sections:

- 1. Division 03 Section "Cast-in-Place Concrete" for cast-in-place concrete for equipment bases/pads for gate operators and controls and post footings.
- 2. Division 26 Sections for electrical service and connections for motor operators, controls, limit and disconnect switches, and safety features and for system disconnect switches.

##### 1.3 PERFORMANCE REQUIREMENTS

- a. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads.

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

- 1. Fence and gate posts, rails, and fittings.
- 2. Chain-link fabric, reinforcements, and attachments.
- 3. Gates and hardware.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

## 1.5 QUALITY ASSURANCE

- A. Pre-installation Conference: Conduct conference at Project site.
  - 1. Review required testing, inspecting, and certifying procedures.
  - 2. Coordination of new fencing installation and removal of existing fencing.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer/Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### 2.1 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:
  - 1. Fabric Height: As indicated on Drawings.
  - 2. Steel Wire Fabric: Wire with a diameter of 0.192 inch (6 gauge).
    - a. Mesh Size: 2 inches.
    - b. Zinc-Coated Fabric: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied after weaving.
    - c. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.
  - 3. Selvage: Twisted top and knuckled bottom.

## 2.2 FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:
1. Fence Height: As indicated on Drawings.
  2. Heavy Industrial Strength: Material Group IA, round steel pipe, Schedule 40.
    - a. Line Post: 4.0 inches.
    - b. End, Corner and Pull Post: 4.0 inches.
  3. Horizontal Framework Members: Top and bottom rails complying with ASTM F 1043, 1 5/8 inch diameter.
  4. Brace Rails: Comply with ASTM F 1043, 1 5/8 inch diameter.
  5. Metallic Coating for Steel Framing:
    - a. Type A, consisting of not less than minimum 2.0-oz./sq. ft. average zinc coating per ASTM A 123/A 123M.

## 2.3 SWING GATES

- A. General: Comply with ASTM F 900 for gate posts and single swing gate types.
1. Gate Leaf Width: As indicated.
  2. Gate Fabric Height: As indicated.
- B. Pipe and Tubing:
1. Zinc-Coated Steel: Comply with ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framing.
  2. Gate Posts: Round tubular steel.
  3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded.
- D. Hardware:
1. Hinges: 180-degree inward swing.
  2. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
  3. Padlock and Chain: Owner will provide locks.
  4. Lock: Closer: Manufacturer's standard.

## 2.4 FITTINGS

- A. General: Comply with ASTM F 626.
- B. Rail and Brace Ends: For each gate, corner, pull, and end post.
- C. Rail Fittings: Provide the following:
  - 1. Top Rail Sleeves: Round-steel tubing not less than 6 inches long.
  - 2. Rail Clamps: Line and corner boulevard clamps for connecting bottom rails in the fence line-to-line posts.
- D. Tension and Brace Bands: Pressed steel.
- E. Tension Bars: Steel length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- F. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- G. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
  - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
    - a. Hot-Dip Galvanized Steel: 0.106-inch; galvanized coating thickness matching coating thickness of chain-link fence fabric.
- H. Finish:
  - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.

## 2.5 GROUT AND ANCHORING CEMENT

- A. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
  - 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect/Engineer/Construction Manager.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

**3.3 INSTALLATION, GENERAL**

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.

**3.4 CHAIN-LINK FENCE INSTALLATION**

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
- D. Line Posts: Space line posts uniformly at 10 feet o.c.
- E. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail

at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

- F. Bottom Rails: Install and secure to posts with fittings.
- G. Chain-Link Fabric: Prior to placing fabric, excavate trench for placement of fence anchoring concrete. Apply fabric to outside of enclosing framework. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released. Pour anchoring concrete as shown on the plans embedding 3-inches of the fabric in the concrete.
- H. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.
- I. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
  - 1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
- J. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

### 3.5 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

### 3.6 FIELD QUALITY CONTROL

### 3.7 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware, gate operator, and other moving parts.

END OF SECTION 32 3113

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## **SECTION 33 41 00**

### **STORM UTILITY DRAINAGE PIPING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

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

##### **1.2 SUMMARY**

- A. Section Includes:

1. Pipe and fittings.
2. Nonpressure transition couplings.
3. Pressure pipe couplings.
4. Expansion joints and deflection fittings.
5. Drains.
6. Encasement for piping.
7. Manholes.
8. Channel drainage systems.
9. Catch basins.
10. Stormwater inlets.
11. Stormwater detention structures.
12. Pipe outlets.
13. Stormwater disposal systems.
14. Stormwater Management Facilities
15. Sectional Track Perimeter Drain
16. Infield Edge Drains

- B. Delaware Department of Transportation (DelDOT) Standard Specifications.

- C. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.

##### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins: Include plans, elevations, sections, details, frames, covers, and grates.
3. Piping: Include manufacturer's certification for each pipe type.
4. Stormwater Management Facility Outlet Structures.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins according to manufacturer's written rigging instructions.

#### 1.5 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  1. Notify Architect/Engineer, Construction Manager and Owner no fewer than two days in advance of proposed interruption of service.

### **PART 2 - PRODUCTS**

#### 2.1 PIPING

- A. All storm drainage piping shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

#### 2.2 MANHOLES

- A. All storm water manholes shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

#### 2.3 CATCH BASINS

- A. All catch basins shall be as shown on the plans and in accordance with the DelDOT Standard specifications.

## 2.4 STORMWATER MANAGEMENT STRUCTURES

- A. All structures shall be as shown on the plans and in accordance with either the DelDOT Standard Specifications or the DNREC Erosion and Sediment Control Handbook.

## 2.5 SECTIONAL TRACK PERIMETER DRAIN

- A. Utilize ACO Sport System #4020 at track perimeter and Sport System #2000 at 'D' Areas, as manufactured by Sports Field Specialties, Delhi, N.Y. 13753, (607) 746-8911; Pro Channel Drain #SE426 at track perimeter and 'XT' slot drain at 'D' Areas as manufactured by Sports Edge, ABT, Inc., Troutman, N.C. (800) 334-6057; or approved equivalent. Drain shall be furnished with eight (8) catch basins with removable trash buckets.
- B. Drain shall be connected at the 8 catch basin locations to the field's collector drainage system, as shown on plans and detailed.
- C. Provide manufacturer's descriptive information for these products for approval as well installation instructions and procedures.

## 2.6 "HYDROBLOX" INFIELD EDGE DRAINS

- A. Hydroblox is a prefabricated thermoplastic non-clogging drainage plank approximately 2"x 9"x 40" long, installed in a single line a 4-5" wide trench that is cut with hand trenching equipment.
- B. Provide the hydroblox where shown and detailed at the circular edge of skinned infields starting at the center of the skinned area, and sloping at no less than 0.50% toward either side of the infield to discharge points a shown on plans. The initial high point of the trench should be cut to a level that the top of the hydroblox plank is positioned at or slightly below the level of the subgrade at the circular edge of the infield.
- C. Upon completion of trenching and installation of the Hydroblox, backfill and clean excess soil from trenches, ready for seeding.

## **PART 3 - EXECUTION**

### 3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

### 3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, non-pressure drainage piping according to DelDOT Standard Specifications.

### 3.4 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated in accordance with the DelDOT Standard Specifications.

### 3.5 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated in accordance with the DelDOT Standard Specifications.

### 3.6 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
  - 1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
  - 1. Remove manhole or structure and close open ends of remaining piping.

- C. Backfill to grade according to Division 31 Section "Earth Moving."

### 3.7 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

### 3.8 CLEANING

- A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 33 41 00

## **SECTION 33 46 00**

### **SUBDRAINAGE**

#### **PART 1 - GENERAL**

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Perforated-wall pipe and fittings.
  - 2. Geotextile filter fabrics.
- B. Delaware Department of Transportation (DelDOT) Standard Specifications.
- C. Delaware Department of Natural Resources and Environmental Control (DNREC) Erosion and Sediment Control Handbook.

##### 1.3 SUBMITTALS

- A. Product Data:
  - 1. Drainage conduits.
  - 2. Geotextile filter fabrics.

#### **PART 2 - PRODUCTS**

##### 2.1 PERFORATED-WALL PIPES AND FITTINGS

- A. Perforated PE Pipe and Fittings:
  - 1. Shall meet the requirements of Advanced Drainage Systems, Inc (ADS) for all pipe sizes or approved equal.

##### 2.2 SOIL MATERIALS

- A. Soil materials are specified in Division 31 Section "Earth Moving."

### 2.3 GEOTEXTILE FILTER FABRICS

- A. Description: Geotextile fabrics shall meet the requirements of Mirafi 140N or approved equal.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where sub-drainage systems are to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

### 3.3 UNDERSLAB DRAINAGE INSTALLATION

- A. Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 4 inches between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- D. Add drainage course to width of at least 4 inches on side away from wall and to top of pipe to perform tests.
- E. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

### 3.4 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Lay perforated pipe with perforations down.
  2. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

### 3.5 PIPE JOINT CONSTRUCTION

- A. Join perforated PE pipe and fittings with couplings according to manufacture's requirements..

### 3.6 IDENTIFICATION

- A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Division 31 Section "Earth Moving."
1. Install PE warning tape or detectable warning tape over ferrous piping.

### 3.7 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
  2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.
- B. Drain piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.8 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 33 46 00

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