

SECTION 116500 – ATHLETIC & RECREATIONAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following outdoor field equipment:
 - 1. Foul Pole
 - 2. Skinned Infield (bags)
 - 3. Skinned Infield (bulk)
 - 4. Mound Clay Blocks
 - 5. Outfield Fence Cover
 - 6. Warning Track
 - 7. Softball Bases and Pitching Rubber
- B. Related Sections include the following:
 - 1. Division 03 Section “Cast In Place Concrete” for criteria for structural concrete bases for sport equipment.
 - 2. Division 32 Section “Chain Link Fences and Gates” and “Decorative Metal Fences and Gates” for fences at sport fields.
 - 3. Division 32 Section “Concrete Paving” for concrete pads and walks associated with sport fields.

1.3 DEFINITIONS

- A. NCAA: National Collegiate Athletic Association

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
- B. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation including loads, footing and foundation design for football goal posts.
- C. Coordination Drawings: Layout plans, drawn to scale, and coordinating locations of all field equipment and space requirements.
- D. Samples for Initial Selection: For each type of equipment offering a color selection.
- E. Samples for Verification:

1. Actual material sample of material in color(s) selected. Provide sample that is approximately 8-inches square or (for extrusions and linear items) 12-inches long.

F. Product Certificates: For each type of equipment, signed by product manufacturer.

G. Qualification Data: For installer.

H. Operation and Maintenance Data: For equipment to include in operation and maintenance manuals.

I. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

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

B. Conform to the latest rules and regulations of the NCAA.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify position and elevation of equipment. Coordinate fully with finish grading elevations and finish paving elevations.

B. Install only when other site work is completed to a point that ensures no displacement of installed athletic field equipment.

C. Install equipment only when weather conditions and soil conditions are in a range acceptable to the equipment manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of field sport equipment 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 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extruded Bars, Profiles, and Tubes: ASTM B 221.
2. Cast Aluminum: ASTM B 179.
3. Flat Sheet: ASTM B 209.

B. Steel: Comply with the following:

1. Steel Plates, Shapes, and Bars: ASTM A 36.
 2. Steel Tubing: ASTM A 500 or ASTM A 513, cold formed.
 3. Steel Sheet: ASTM A 1011.
 4. Stainless Steel Sheet, Strip, Plate, and Flat Bar: ASTM A 666.
 5. Stainless Steel Bars and Shapes: ASTM A 276
- C. Anchors, Fasteners, Fittings and Hardware: Manufacturer’s standard corrosion-resistant or noncorrodible units; concealed.
- D. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 with minimum strength recommended in writing by equipment manufacturer.

2.2 SPORTS EQUIPMENT

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated as the basis of design or the most comparable product by one of the other named manufacturers. If product number given for the “other named” manufacturers is not the closest possible to the basis of design, advise Engineer and submit the product that IS most close to the basis of design.
- B. Softball Foul Pole:
1. 20’ above ground.
 2. 6" diameter aluminum tube.
 3. Color: white
 4. 1-1/2" aluminum lockcrimp mesh.
 5. Powder-coated finish.
 6. Products:
 - a. Basis of Design: Sportsfield Specialties (FPW420)
 - b. Aluminum Athletic Equipment Co.
 - c. UCS
- C. Skinned Infield (Pre-packaged): Provide one of the following:
1. Basis of Design: Dura-Edge Collegiate
 2. Diamond Pro
 3. Kurtz Brothers
- D. Skinned Infield (Field Mixed): Mix design recommendations as follows:
1. 65% sand of which, 50% is composed of a round, uniform (masonry-type) sand and 50% is composed of sharp, angular, manufactured sand that is often used by city street departments for roads or by highway departments for crack and seal sand.
 - a. The round sand shall be uniform, medium/coarse sand screened and washed meeting the following criteria:

Fraction Size Name	Sieve Diameter (mm)	Allowable Range (% Retained on Sieve)
Gravel	>2.00	<3%
Very Coarse	1 mm – 2 mm	<7%
Coarse	0.5 mm – 1 mm	At least 60% particles
Medium	0.25 mm – 0.5 mm	In this range

- b. The manufactured, angular sand shall be screened and washed meeting the following criteria:

Fraction Size Name	Sieve Diameter (mm)	Allowable Range (% Retained on Sieve)
Gravel	>2.00	<25%
Very Coarse	1 mm – 2 mm	At least 50% particles

Coarse	0.5 mm – 1 mm	In this range
Medium	0.25 mm – 0.5 mm	<15%
Fines	<0.25 mm	<3%

2. 15% silt
3. 20% clay

E. Coarse calcined clay or infield conditioner

1. The calcined clay/ infield conditioner shall be of the coarser material meeting the following criteria:

Fraction Size Name	Sieve Diameter (mm)	Allowable Range (% Retained on Sieve)
Gravel	>2.00	>40%
Very Coarse	1 mm – 2 mm	>40%
Coarse	0.5 mm – 1 mm	>10%
Medium	0.25 mm – 0.5 mm	<0.5%
Fines	<0.25 mm	<0.1%

2. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Basis of Design: Dura-Edge Fair Ball
 - b. Turface; Profile Products, LLC
 - c. Infield Conditioner/Infield Top Dressing; Diamond Pro

F. Pitching Mound/Batter's Box Clay Blocks

1. Provide 2.5"x4"x8" pitching mound clay blocks.
2. 100% pure virgin clay
3. Red in color.
4. 1 mounds total, 2 batter's box total, 1 catcher's box
5. Products:
 - a. Basis of Design: Dura-Edge Pro Loc
 - b. Turface Athletics MoundMaster Blocks
 - c. Diamond Pro Mound/Home Plate Clay Bricks

G. Premium Outfield Fence Cover: Chain link top rail fence cover to be installed on all fence rails adjacent to warning track.

1. Include a 3" W x 4-1/2" H x 8' L UV resistant polyethylene cover with a minimum .09" thick wall.
2. 8" L fasteners to be installed in drilled holes every 24" o.c.
3. Color: Yellow
4. 4" diameter corrugated covers are prohibited.

H. Warning Track

1. The subgrade shall be prepared at a uniform depth of 4 inches below finished grade.
2. Install 8 mil black polyethylene with herbicide.
3. Provide 4" of red crushed brick.
4. See drawings for limits.

I. Softball Bases and Pitching Rubber

1. Provide 3 bases complete with anchors and plugs.
2. 15" x 15" x 3" bases.
3. 8" ground anchor – 1 3/4" square.
4. Mushroom Plug
5. Provide bury-all home plate.
6. Provide pitcher's rubber complete with anchors and plugs.
7. Step-down style pitching rubber.
8. Products:

- a. Basis of Design: Schutt – Jack Corbett Hollywood Bases #129010XX, Ground Anchors #12916550, Mushroom Plug #12916580, Hollywood Bury-All Home Plate #12908170, 24" Step Down Pitching Rubber #1909190
- b. Bolco
- c. AFP

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for position, elevation and alignment of mounting substrates, installation tolerances, operational clearances and other conditions affecting performance.
 1. Verify critical dimensions.
 2. Examine supporting structure and subgrades, and footings.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions and competition rules applicable to each type of equipment. Complete equipment field assembly, where required.
- B. Unless otherwise indicated, install equipment after interfacing final grades and paving have been completed.
- C. Permanently Placed Equipment and Components: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with filed sport layout.
- D. Insert Setting: Position sleeve in oversized, recessed voids in concrete and footings. Clean voids of debris. Fill void around sleeves with grout, mixed and placed to comply with grout manufacturer's written instructions.
- E. Anchoring to In-Place Construction: Use anchors and fasteners where necessary for securing built-in and permanently placed equipment to structural support and for properly transferring load to in-place construction.

3.3 INSTALLATION

- A. Skinned Infield: See Drawings for elevations. Grade to ¼ inch variation in 10 feet for flat, sloped, or curved profiles.
 1. The subgrade shall be prepared at a uniform depth of 6 inches below the finished grade.
 2. The subgrade shall then be rolled with a 3 to 5 ton roller, or other suitable roller, and the surface lightly scarified to insure bonding with the sand clay mixture.
 3. If placing a pre-packaged infield mix, spread evenly to a loose depth so that the compacted depth will be 6 inches.
 4. If preparing a field-mixed infield mix:
 - a. Evenly spread a layer of clay on the prepared subgrade and thereon a layer of sand to such a loose depth that, when compacted, the material mixed together shall be the required 6 inch depth. The order of spreading the sand and clay may be reversed if required by the Engineer.

- b. These 2 layers shall then be thoroughly mixed and pulverized in place and spread by a minimum of 6 passes by a roto tiller or other approved mechanical means, shaped, and compacted to a uniform depth and approved by the Architect. If the moisture content is such as not to permit satisfactory compaction, water shall be added under his direction.
- 5. Apply "soil conditioner" at the rate of eight 50 lb bags per 100 sq ft., equal to 12-1/2 sq ft per bag, each bag at the center of a square measuring 42-1/2 inches on each side. After emptying the bags, level the piles of "soil conditioner" with rakes or tractor grading blade to a uniform thickness. By use of a rototiller, disc cultivator, tiller rake, or tine harrow, thoroughly mix "soil conditioner" in an evenly blended layer in the top 3 inches. The preferred implement is a tractor mounted rototiller. A half ton or one ton power roller will compact the loose mixture to the required firmness.

- B. Install protective pads in strict accordance with manufacturer's recommendations and as located on the plans.

3.4 ADJUSTING

- A. Adjust components to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

3.5 CLEANING

- A. After completing equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.
- B. Replace equipment and finishes that cannot be cleaned and repaired, in a manner approved by Engineer, before time of Substantial Completion.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 116500

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and ITB Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protecting existing trees, shrubs, groundcovers, plants, and grass, to remain.
 - 2. Removing existing trees, shrubs, groundcovers, plants, and grass as indicated on drawings.
 - 3. Clearing and grubbing.
 - 4. Removing above- and below-grade site improvements.
 - 5. Disconnecting, capping or sealing, and removing site utilities.
 - 6. Temporary erosion and sedimentation control measures.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

- A. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in ITB Sections.

1.5 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 authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- 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 requirements of authorities having jurisdiction and in accordance with sediment and erosion control Drawings.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
 - 1. Do not store construction materials, debris, or excavated material within fenced area.
 - 2. Do not permit vehicles, equipment, or foot traffic within fenced area.

3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.

3.4 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

B. 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 Construction Manager not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Construction Manager's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, 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. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.

4. Use only hand methods for grubbing within tree protection zone.

5. Chip removed tree branches and dispose of off-site.

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 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as 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 length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

- A. Disposal: 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.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and ITB Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Drainage course for slabs-on-grade.
 - 4. Subbase course for concrete walks and pavements.
- B. Related Sections include the following:
 - 1. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 2. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.
 - 3. Division 32 Section "Plants" for planting bed establishment and tree and shrub pit excavation and planting.

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: Course placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course 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.

- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Geotextile.
 - 2. Controlled low-strength material, including design mixture.
- B. Qualification Data: For field builder including list of relevant projects as described in section 1.5.D.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
- B. Geotechnical Testing Agency Qualifications: Owner will employ and pay a qualified, independent geotechnical testing laboratory to perform soil testing and inspection services during earthwork operations. Contractor shall be responsible for scheduling and coordination of these services.
- C. Preexcavation Conference: Before commencing earthwork, meet with representatives of governing authorities, Owner, Engineer, Structural Engineer, consultants, Geotechnical Testing Agency and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least three working days prior to convening conference. Record discussions and agreements and furnish a copy to each attendee.
- D. Sports laser Builder(Installer)'s Experience:
 - 1. The athletic field builder shall have the experience of at least Ten (5) acceptable varsity NCAA natural grass installations within the past five (5) years.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Construction Manager and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Construction Manager's written permission.
 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide off-site borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.
- B. Satisfactory Soils: On site soils satisfactory to testing agency, containing less than 25% pulverized shale fragments, free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, organics, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Silt, highly organic soils, wood, roots, trash, debris, and other soils and materials not acceptable to the testing agency.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; as noted on drawings.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; as noted on the drawings.

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 earthwork operations.
- B. Protect and maintain erosion and sedimentation controls during earthwork operations.
- C. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

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 utility trenches as temporary drainage ditches.
 - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.6 EXCAVATION FOR UTILITY TRENCHES

- A. For sanitary sewer, storm sewer, and water lines, please see the corresponding spec sections. For other site utilities follow below.
- B. 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.
- C. 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.
- D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

- A. Notify testing agency when excavations have reached required subgrade.
- B. If testing agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Construction Manager, without additional compensation.

3.8 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 may be used when approved by Geotechnical Engineer.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Construction Manager.

3.9 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.

3.10 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

- A. For sanitary sewer, storm sewer, and water lines, please see the corresponding spec sections. For other site utility backfill, follow below.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.
- C. 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.
- D. 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.
- E. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- F. Place and compact initial backfill material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit in non-paved areas.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit in paved areas.
- H. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

- I. Place and compact final backfill of satisfactory soil to final subgrade elevation in non-paved areas.
- J. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation in paved areas.

3.12 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 in accordance with sections 3.13 and 3.14 and as follows:
 - 1. Under grass and planted areas, use satisfactory soil material or engineered fill.
 - 2. Under walks and pavements, use satisfactory soil material (excluding topsoil) or engineered fill.
 - 3. Under steps and ramps, use satisfactory soil material (excluding topsoil) or engineered fill.
 - 4. Under building slabs, use satisfactory soil material (excluding topsoil) or engineered fill.
 - 5. Under footings and foundations, use satisfactory (excluding topsoil) soil material or engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 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.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, including 10 feet beyond all such areas, compact each layer of backfill or fill soil material at 100 percent maximum dry density.

2. Under walkways, compact each layer of backfill or fill soil material at 100 percent maximum dry density.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent maximum dry density.
4. For utility trenches, compact each layer of initial and final backfill soil material at 100 percent maximum dry density.

3.15 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.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 1. Non-Athletic Field Lawn or Unpaved Areas: Plus or minus 1 inch.
 2. Athletic Field Area: Plus or minus 1/2 inch. **Must be laser graded.**
 3. Walks: Plus or minus 1 inch.
 4. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

3.17 SUBBASE AND BASE COURSES

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:

1. Where specified install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Shape subbase and base course to required crown elevations and cross-slope grades.
 3. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 4. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry density.
- C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 100 percent of maximum dry density.

3.18 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.20 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 Construction Manager; reshape and recompact.
- 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.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Transport surplus soil material offsite to a legal disposal site off Owner's property.
 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
- B. Excavated pavements shall be considered waste material and shall not be incorporated into fills.

END OF SECTION 312000

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and ITB Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Driveways and roadways.
 - 2. Parking lots.
 - 3. Curbs and gutters.
 - 4. Walkways.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.

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. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- C. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Curing compounds.

4. Applied finish materials.

D. Jointing Plan

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

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

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.

- C. ACI Publications:

1. Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
2. Comply with ACI 330, "Guide for Design and Construction of Concrete Parking Lot" unless modified by requirements in the Contract Documents.
3. Comply with ACI 325, "Design of Jointed Concrete Pavements for Streets and Local Roads" unless modified by requirements in the Contract Documents.

- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in ITB Sections.

1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:

- a. Contractor's superintendent.
- b. Independent testing agency responsible for concrete design mixtures.
- c. Ready-mix concrete producer.
- d. Concrete pavement 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 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.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 - 1. Use flexible or curved forms for curves with a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.
- C. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- D. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- E. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- F. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.
- G. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- H. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- I. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

J. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

K. Zinc Repair Material: ASTM A 780.

2.4 CONCRETE MATERIALS

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

1. Portland Cement: ASTM C 150, Type I., gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.

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

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material when steel reinforcement is called out in exterior installations.

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

2.5 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. Dry, delivered pre-wetted and soaked.

- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM 1752 Vinyl full depth, with joint sealant.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 4000 psi, unless otherwise indicated on the drawings.
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 3 inches, or up to 5 inches with the use of a water-reducing chemical admixture.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements and as follows:
 - 1. Fly Ash or Pozzolan: 25 percent.
 - 2. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- G. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades
 - 1. Proof rolling to be performed in presence of Engineer or Construction Manager.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, Construction Manager, or Geotechnical Engineer, and replace with compacted backfill or fill as directed.
- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

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 for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- 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: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain 2" minimum cover to reinforcement.

- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, or through locations of intended contraction or isolation joints, unless otherwise indicated.
 - 2. Provide tie bars at sides of pavement strips where indicated.
 - 3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic . Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.
- C. Isolation (expansion) Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of not more than 30 feet, 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. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
 - 6. Apply joint sealant / caulk.
 - 7. Doweled Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic . Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.

- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. For thickness 5 inches or less construct contraction joints for a depth equal to at least one-third of the concrete thickness, for thickness greater than 5 inches construct contraction joints for a depth equal to at least one-quarter of the concrete thickness, as follows or match jointing of existing adjacent concrete pavement:
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. Eliminate groover marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic . Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed if plastic shrinkage cracking is of concern.
- D. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- E. Comply with ACI 301 and ASTM C94, requirements for measuring, mixing, transporting, and placing concrete.
- F. A one time add of water to concrete during delivery or at Project site is permitted but the water to cementitious material ratio must not be violated.
- G. Do not add water to fresh concrete after testing.
- H. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- I. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms.

Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

- J. Screed pavement surfaces with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- M. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- O. 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 air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
- P. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven

floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated prior to placement and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. 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.

3.9 TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 1. Elevation: 1/4 inch.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/4 inch.
 4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
 5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
 6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least 1 composite sample for each 5000 sq. ft. or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/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 mix. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Engineer, 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. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.

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

END OF SECTION 321313

SECTION 323113 - 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 ITB Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Chain-Link Fences
 - 2. Gates
- B. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving" for site excavation, fill, and backfill where chain-link fences and gates are located.

1.3 SUBMITTALS

- A. Product Data: 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.
 - 4. Gate operators, including operating instructions.
 - 5. Accessories: Privacy slats.
 - 6. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Show locations of fences, gates, posts, rails, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. UL Standard: Provide gate operators that comply with UL 325.
- C. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in ITB Sections.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

- A. General: Insert height, limited to 12 feet (3.6 m). Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:
1. Steel Wire Fabric: Polymer-coated wire with a diameter of 0.148 inch (3.76 mm).
 - a. Mesh Size: 2 inches (50 mm).
 - b. Polymer Coating: ASTM F 668, Class 2b over metallic-coated steel wire.
 - 1) Color: Black, complying with ASTM F 934.
 - c. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.
 2. Selvage: Knuckled at both selvages.

2.2 INDUSTRIAL FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:
1. Group: IA, round steel pipe, Schedule 40 IC, round steel pipe, yield strength 50,000 psi (345 MPa).
 2. Fence Height: As indicated on drawings.
 3. Strength Requirement: Heavy industrial according to ASTM F 1043.
 4. Post Diameter and Thickness: According to ASTM F 1083.
 5. Post Size and Thickness: According to ASTM F 1083.
 - a. Top Rail: 1.66 inches.
 - b. Steel Line Post:
 - 1) Height up to and including 6 feet – 1.900 inches
 - 2) Height over 6 feet – 2.875 inches
 - c. Steel End, Corner and Pull Post:
 - 1) Height up to and including 6 feet – 2.375 inches
 - 2) Height over 6 feet – 3.500 inches
 - d. Swing Gate Post for fabric height up to and including 6 feet:: According to ASTM F 900 and as follows:
 - 1) Gate leaf width up to and including 4 feet: 2.375 inches OD pipe, 3.11-lb/ft weight
 - 2) Gate leaf width over 4 feet to 10 feet: 2.875 inches OD pipe, 4.64-lb/ft weight.
 - e. Swing Gate Post for fabric height over 6 feet:: According to ASTM F 900 and as follows:
 - 1) Gate leaf width up to and including 6 feet: 2.875 inches OD pipe, 4.64-lb/ft weight

- 2) Gate leaf width over 4 feet to 10 feet: 4.000 inches OD pipe, 8.65-lb/ft weight.
6. Coating for Steel Framing:
 - a. Metallic Coating:
 - 1) Type I Steel Pipe: Type A, consisting of not less than minimum 2.0-oz./sq. ft. (0.61-kg/sq. m) average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. (1.22-kg/sq. m) zinc coating per ASTM A 653/A 653M.
 - 2) Type II Steel Pipe: Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, of 30 plus or minimum 15 micrograms, and a clear, verifiable polymer film of 0.5 plus 0.2 mils. Type B inside with a minimum of 0.9 oz of zinc per sq.ft.
 - b. Polymer coating over metallic coating.

2.3 INDUSTRIAL SWING GATES

- A. General: Comply with ASTM F 900 for single and double swing gate types.
 1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1043 and ASTM F 1083 for materials and protective coatings.
- B. Frames and Bracing: Fabricate members from round, galvanized steel tubing with outside dimension and weight according to ASTM F 900 and the following:
 1. Gate Fabric Height: 2 inches (50 mm) less than adjacent fence height.
 2. Leaf Width: As indicated on drawings.
 3. Frame Members:
 - a. Tubular Steel: 1.66 inches (42 mm) round for gate heights up to and including 6 feet; 1.90 inches (48 mm) round for gate heights over 6 feet.
- C. Frame Corner Construction:
 1. Welded and 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider.
- D. Hardware: Provide galvanized and coated hardware matching the fence specs as necessary and as follows:
 1. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6-foot nominal height.
 2. Latch: Forked type or plunger-bar type to permit operation from either side of gate with padlock eye as integral part of latch.
 3. Keeper: Provide a keeper for vehicle gates that automatically engages gate leaf and holds it in the open position until manually released.
 4. Gate Stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage a center drop rod or plunger bar. Include a locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

2.4 FITTINGS

- A. General: Comply with ASTM F 626.
- B. Post and Line Caps: Provide for each post.
 - 1. Line post caps with loop to receive top rail.
- C. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 - 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches (152 mm) long.
 - 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel, length not less than 2 inches (50 mm) 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.
- 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. Aluminum: ASTM B 211 (ASTM B 211M); Alloy 1350-H19; 0.148-inch- (3.76-mm-) diameter, mill-finished wire.
- H. Finish:
 - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. (366 g /sq. m) zinc.
 - 2. Match Fence materials.

2.5 PRIVACY SLATS

- A. Material: Polyethylene tubular slats, not less than 0.023 inch (0.58 mm) thick, manufactured for chain-link fences from virgin polyethylene containing UV inhibitor, sized to fit mesh specified for direction indicated; with vandal-resistant fasteners and lock strips, and fins for increased privacy factor.
- B. Color: Black.

2.6 CAST-IN-PLACE CONCRETE

- A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water.

1. Concrete Mixes: Normal-weight concrete with not less than 3000-psi (20.7- MPa) compressive strength (28 days), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum size aggregate.

2.7 POLYMER FINISHES

- A. Supplemental Color Coating: In addition to specified metallic coatings for steel, provide fence components with polymer coating.
- B. Metallic-Coated Steel Framing and Fittings: Comply with ASTM F 626 and ASTM F 1043 for polymer coating applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces.
 1. Polymer Coating: Not less than 10-mil- (0.254-mm-) thick PVC finish.
- C. Color: Match chain-link fabric, complying with ASTM F 934.

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.
 1. Do not begin installation before final grading is completed, unless otherwise permitted by Engineer.
 2. 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 (152.5 m) 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 specified.

3.4 CHAIN-LINK FENCE INSTALLATION

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed soil.
 1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
 2. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than the post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

- B. Post Setting: Center and align posts in holes 3 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches (50 mm) above grade; shape and smooth to shed water.
- 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 (3 m) o.c.
- E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at midheight of fabric 6 feet (1.83 m) or higher, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- F. 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.
- G. Bottom Rails: Install, spanning between posts.
- H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches (50 mm) between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, and rails. Anchor to framework so fabric remains under tension after pulling force is released.
- I. 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 (380 mm) o.c.
- J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 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 (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.
- K. 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.
- L. Privacy Slats: Install slats in vertical direction, securely locked in place.

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 ADJUSTING

- A. Gate: Adjust gate 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 and other moving parts.

END OF SECTION 323113

SECTION 328400 – UNDERGROUND IRRIGATION SYSTEM

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and ITB sections, apply to work of this section.
 - 1. Division 32 Section 329300 “Exterior Plants”.
 - 2. Division 32 Section 329200 “Turf and Grasses”.

1.02 DESCRIPTION OF WORK

General:

- A. The system shall provide 100% coverage and uniformly irrigate all zones and perform as required:
 - 1. The contractor shall provide an underground irrigation system drawing and adhere to these specifications.
 - a) Automatic irrigation system including piping, fittings, sprinkler heads, control wire, quick coupler valves, controllers, smart system, and accessories.
 - b) Excavating and backfilling irrigation system work.
 - c) Testing and adjusting of system.
 - d) “As – Built” drawings
 - e) Winterization – shutdown – spring start-up
 - 2. All work required by the contractor’s plans and these specifications shall be accomplished by the Irrigation Contractor even though minor items required may not be specifically mentioned in the above listing.
- B. Drawings: The irrigation layout is diagrammatic. Exact locations of piping, sprinkler heads, valves, and other components shall be by the Contractor. Modifications in the field at time of installation to allow for actual on site conditions are acceptable. Proper spacing of sprinkler heads will be required to obtain satisfactory coverage. Minor adjustments in the system layout will be permitted to clear fixed obstructions. Any major revisions to the irrigation system shall be submitted in writing to the owner for approval. The final system layout must be acceptable to the owner.
- C. Verification of Plans and Specifications: It shall be the responsibility of the Irrigation Contractor to carefully examine the irrigation zones and specifications relating to this work for completeness, accuracy, and clarity. Any conflict errors or clarifications request shall be immediately brought to the attention of the owner’s representative for written interpretation or instructions. No claim for increased compensation for additions, changes, or alterations will be considered unless written authorization is granted by Owner’s representative. Otherwise any additional materials and/or labor due to existing conditions shall be furnished under this contract.
- D. Irrigation Contractor is responsible for obtaining all permits required for installation of this work.
- E. Irrigation contractor to ensure that the general contractor provides required power to irrigation system.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide underground irrigation system as a complete unit produced by a single acceptable manufacturer, including heads, valves, controls, smart system and accessories.
- B. Work and materials shall be in accordance with the latest rules, and other applicable state or local laws. Nothing in the Contract Documents is to be construed to permit work not conforming to these codes.
- C. Contractors Qualifications: Bidding contractors shall have a minimum of three years experience in the construction of a job of similar size and complexity.
 - 1. Provide the General Contractor a list of five equivalent, irrigation system installations, performed in the last five years, incorporating the following information:
 - a) Name and address of product.
 - b) Name and address of Owner.
 - 1) Contact person
 - c) Name and address with whom contact was with.
 - 1) Contact person
- D. Requirements of regulatory agencies and utilities:
 - 1. System shall comply with the latest requirements of all state and local codes and ordinances.
 - 2. System shall comply with the latest rules and requirements by all utility companies involved.
 - 3. Nothing in the contract documents is to be constructed to permit work not conforming to these rules, codes and ordinances.
- E. Electrical devices shall carry Underwriter's Laboratory labels.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions for underground irrigation system.
- B. Record Drawings: After completion of the work and before final acceptance, a set of scaled, reproducible record drawings, and two sets of prints showing the location of the complete work shall be submitted to the Owner. Final payment and any retainage will not be released until these drawings are submitted and accepted by the Owner.
- C. Submit a weekly irrigation schedule based on an annual evapotranspiration rate, average rainfall amounts etc.

1.05 WARRANTY

- A. The contractor shall furnish a manufacturer's written warranty to the effect that all heads, valves, smart system, and controllers will be warranted for a period of no less than one year to be free from defects and faulty workmanship, and that any defective heads, valves, or controllers shall be promptly repaired or replaced without additional cost to the Owner in accordance with that warranty.
- B. All materials other than those referred to in Paragraph A above shall be warranted for a period of one full year from the date of final acceptance by the Owner.
- C. All installation labor used on this project will be warranted for one full year from date of final acceptance by the Owner.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
1. Rain Bird Sprinkler Mfg. Corp.

2.02 MATERIALS

- A. Pressure Pipe: Comply with following:
1. Unplasticized PVC pipe, Class 200 SDR21, ASTM D 2241.
 - a) 3" and larger, may be installed with slip joint ring gasket seals.
 - b) 2-1/2" and smaller shall be installed using solvent weld joints.
 2. Dripper Tubing with Pressure Compensating Emitters
- B. Circuit Pipe (downstream from circuit valves): Comply with following:
1. Unplasticized PVC pipe, Class 200 SDR-21, ASTM D 2241.
 2. Virgin Polyethylene tubing, 80 pound minimum N.S.F. approved, ASTM D2239.
- C. Pipe Fittings: Comply with following:
1. For PVC plastic pipe, Approved socket fittings to be used with ASTM D2241 pipe and ASTM D2564 solvent cement.
 2. For polyethylene (PE) plastic pipe, plastic insert fittings, ASTM D2609.
- D. Valves: Manufacturer's standard, of type and size indicated, and as follows:
1. Provide PVC or cast bronze bodies, as called for on plans.
 2. Provide pressure regulating valves, if called for on plans.
 3. Manual Circuit Valves: Globe valves.
 4. Key Operated Valves: Manual valves, fitted for key operation.
 - a) Furnish 2 valve keys, 3 feet long with tee handles and key end to fit valves.
 5. Automatic Circuit valves Globe valves operated by low-power solenoid, normally closed, manual flow adjustment.
 6. Automatic Drain Valves: Designed to open for drainage when line pressure drops below 3 psi.
- E. Backflow Preventer: As required by governing code.
- F. Sprinkler Heads: Manufacturer's standard unit designed to provide uniform coverage over entire area of spray shown on drawings at available water pressure, as follows:
1. Bubbler: Fixed pattern, pressure compensating type.
 2. Shrubbery: Fixed pattern, pressure compensating type
 3. Pop-Up Spray: Fixed pattern, with screw-type flow adjustment or pressure regulating nozzle and stainless steel retraction spring.
 4. Pop-Up Rotary Spray: Gear drive, full circle and adjustable part circle type.
 5. Pop-Up Rotary Impact: Impact drive, full circle and part circle as indicated.
 6. Above Ground Rotary Impact: Impact drive, full circle and part circle as indicated.
- G. Valve Box: Valve Access Box: Tapered rib reinforced enclosure of rigid plastic material comprised of polyolefin fibrous components chemically inert and unaffected by moisture, ultraviolet light, corrosion and temperature changes. Provide lid of same material, green in color with light, corrosion and temperature changes. Provide lid of same material, green in color with snap lock cover. AMETEK or approved equal (10" round minimum size) allowed.

- H. Valve Cover and Frame: Industrial Grade Plastic.
- I. Wiring: UF type single strand wire #14 with white common ground and others color coded.
 - 1. Connections: Suitable moisture proof device; 3M pack or Rain Bird snap type connector.
 - 2. Each lateral Line must also have a 14AWG Single strand wire attached for location purposes as required by the university.
- J. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3" maximum to $\frac{3}{4}$ " minimum.

2.03 AUTOMATIC CONTROL SYSTEM

- A. General: Furnish low voltage system manufactured expressly for control of automatic circuit valves of underground irrigation systems. Provide unit of capacity to suit number of circuits as indicated.
- B. Exterior Control Enclosure: Manufacturer's standard weatherproof enclosure with locking cover, complying with NFPA 70 (National Electric Code).
- C. Interior Control Enclosure: Manufacturer's standard with locking cover, complying with NFPA 70.
- D. Transformer: To convert building service voltage to control voltage of 24 volts.
- E. Circuit Control:
 - 1. Input: 120 VAC, 60Hz, 0.2A
 - 2. Output: 25.5 VAC, 60Hz, 0.65A
 - 3. Power back-up: 2 x AAA batteries maintain time and date while nonvolatile memory maintains the programming
- F. Smart System Control Device:
 - 1. Station timing: 0 to 199 min
 - 2. Seasonal Adjust; -90% to +100%
 - 3. Independent schedule per zone
 - 4. 6 Start Times per zone
 - 5. Program Day Cycles include Custom days of the week, Odd, Even, & Cyclical dates
 - 6. Manual Watering SINGLE zone
 - 7. Manual Watering ALL zones

PART 3 – EXECUTION

3.01 SYSTEM DESIGN

- A. Design Pressures: As indicated on contractor's drawings, at connection to building system and at last head in circuit.
- B. Location of Heads: As indicated on drawings. Make minor adjustments as necessary to avoid plantings and other obstructions.
- C. Minimum Water Coverage:
 - 1. Turf areas, 100%
 - 2. Planting areas, 100%.

3. Layout may be modified, if necessary to obtain coverage, to suit manufacturer's standard heads. Do not decrease number of heads indicated on contractor's drawings unless otherwise acceptable to Engineer/Owners Representative.

3.02 TRENCHING AND BACKFILLING

- A. General: Excavate straight and true with bottom uniformly sloped to low points.
 1. Protect existing lawns and plantings. Remove and replant as necessary to complete installation. Replace damaged lawn areas plants and mulch with new to match existing.
- B. Trench Depth: Excavate trenches to a depth of 3" below invert of pipe, unless otherwise indicated.
- C. Minimum Cover: Provide following minimum cover over top of installed piping: A minimum of 18" cover shall be held over all main lines and lateral lines 1" thru 2" in diameter, and a minimum of 24" of cover for pipe sizes 2-1/2" thru 3" diameter. Pipe sizes between 4" and 6" in diameter should have a minimum of 30" of cover.
- D. Backfill: Backfill with clean material from excavation. Remove organic material as well as rocks and debris larger than 1" diameter. Place acceptable backfill material in 6" lifts, compacting each lift.
- E. Existing Lawns: Where trenching is required across existing lawns, uniformly cut strips of sod 6" wider than trench. Remove sod in rolls of suitable size for handling and keep moistened until replanted.
- F. Backfill trench to within 6" of finished grade. Continue fill with acceptable topsoil and compact to bring sod even with existing lawn.
- G. Replant or replace sod within 7 days after removal, roll and water generously.
- H. Reseed and restore to original condition any sod areas not in healthy condition equal to adjoining lawns 30 days after replanting.
- I. Pavements: Where existing pavements must be cut to install irrigation system, cut smoothly to straight lines 6" wider than trench.
 1. Excavate trench to required depth and width.
 2. Remove cut-out pavement and excavated material from site.
 3. At walkways, jack piping under paving material, if possible.
 4. Backfill with dry sand fill material, placing in 6-inch lifts.
 5. Repair or replace pavement cuts with equivalent materials and finishes.

3.03 NOT USED

3.04 INSTALLATION

- A. General: Unless otherwise indicated, comply with requirements of Uniform Plumbing Code.
- B. Connection to Main: Connect to existing building piping in location indicated.
 1. Install new tee, valve, and union.
 2. Connect to existing stub. Install new valve and union.
 3. Connect to existing stub with union.

- C. Maintain uninterrupted water service to building during normal working hours. Arrange for temporary water shut-off with Engineer.
- D. Backflow Preventer: Provide union on downstream side. Install approved back flow prevention device as directed by manufacturer and in a manner approved by state and local codes.
- E. Water Hammer Arrester: Install between connection to building main and circuit valves, inside building or in valve box as indicated.
- F. Circuit Valves: Install in valve box, arranged for easy adjustment and removal.
 - 1. Provide union on downstream side.
 - 2. Adjust automatic control valves to provide flow rate or rated operating pressure required for each sprinkler circuit. If an over pressure condition exists, contractor shall install, at his expense, such pressure compensation devices as are necessary to bring the circuit or heads into proper operating range.
- G. Piping: Lay pipe on solid subbase, uniformly sloped without humps or depressions.
 - 1. For circuit piping, slope to drain valve at least $\frac{1}{2}$ " in 10' or run.
 - 2. At wall penetrations, pack the opening around pipe with non-shrink grout. At exterior face, leave a perimeter slot approximately $\frac{1}{2}$ " wide by $\frac{3}{4}$ " deep. Fill this slot with backer rod and an acceptable elastomeric sealant. Repair below grade waterproofing disturbed by this work and make penetration watertight.
 - 3. Install PVC pipe in dry weather when temperature is above 40 F (4 C) in strict accordance with manufacturer's instructions. Allow joints to cure at least 24 hours at temperature above 40 F (4 C) before testing, unless otherwise recommended by manufacturer.
 - a) Allow joints to cure at least 24 hours at temperature above 40 degrees F (4 degrees C) before testing, unless otherwise recommended by manufacturer.
- H. Drain Pockets: Excavate to sizes indicated. Backfill with acceptable drain material to 12" below grade. Cover drain material with a sheet of 30-pound Asphalt saturated felt and backfill remainder with excavated material.
 - 1. Restore lawns or plantings disturbed by this work.
- I. Sprinkler Heads: Flush circuit lines with full head of water and install heads after hydrostatic test is completed.
 - 1. Install lawn heads at manufacturer's recommended heights.
 - 2. Install shrubbery heads at heights indicated.
 - 3. Locate part-circle heads to maintain a minimum distance of 4" from walls and 2" from other boundaries, unless otherwise indicated.
- J. Wiring : Make all wire splices in valve boxes.
- K. Dielectric Protection: Use dielectric fittings at connection where pipes of dissimilar metal are joined.
- L. Closing of Pipe and Flushing Lines: Cap or plug all openings as soon as lines have been installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of the installation. Thoroughly flush out all main water lines before installing valves. Thoroughly flush out all lateral lines after installation and before attaching heads.

3.05 TESTING AND TRAINING

- A. General: Notify Engineer in writing when testing will be conducted. Conduct tests in presence of Engineer.
- B. Hydrostatic Test: Test water piping and valves, before backfilling trenches, to a hydrostatic pressure of not less than 100 psi. Piping may be tested in sections to expedite work. Remove and repair piping, connections, valves which do not pass hydrostatic testing.
- C. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinkler heads adjusted to final position.
 - 1. Demonstrate to Engineer that system meets coverage requirements and that automatic controls function properly.
 - 2. Coverage requirements are based on operation of one circuit at a time.
- D. After completion of grading, seeding or sodding, and rolling of grass areas, carefully adjust lawn sprinkler heads so they will be flush with or not more than 1/2" above finish grade.
- E. Personnel training
 - 1. Contractor shall be responsible for the training of as many personnel as the Owner shall deem necessary.
 - 2. Contractor shall be responsible for one starting and one winterizing of the system during the appropriate times of the year after final acceptance by the Owner as part of the training of the Owner's personnel.
 - 3. Contractor shall include general troubleshooting and operation of the system with reference to head, valve, and controller operation.
 - 4. Contractor shall furnish a complete operation and maintenance manual to the Owner's personnel. This manual shall include repair parts lists, assembly instructions, troubleshooting guides, programming instructions, and recommended precipitation rates.

3.06 ADJUSTMENT

- A. After completion of grading, seeding or sodding, if applicable, Contractor shall return to the job site to perform any final adjustments to the system, which might be deemed necessary.
- B. The contractor will be responsible for any pressure testing and start up of the system when construction is complete. The contractor will also be responsible for the winterization of the system after the first season of operation.

END SECTION 328400

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Sodding.
- 2. Turf renovation.

- B. Related Requirements:

- 1. Section 329113 "Soil Preparation" for soil material.
- 2. Section 334100 "Storm Drainage" for below-grade drainage of turf areas.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

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

1.5 SUBMITTALS

- A. Qualification Data: For field builder including list of relevant projects as described in section 1.7.A.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
- C. Seed Mix: For sod type.
- D. Sand-based Soil Mix: For soil that sod is grown on.
- E. Product Certificates: For fertilizers, from manufacturer.
- F. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during the first calendar year and a typical calendar year moving forward. Recommendations should include but are not limited to watering frequency, mowing heights, fertilization, aeration and top dressing. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

- A. Sports field Installer Qualifications: A qualified sports field installer whose work has resulted in successful athletic field establishment.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
 - 2. Maintenance Proximity: Not more than one (1) hours' normal travel time from Installer's place of business to Project site.
 - 3. The athletic field builder shall have the experience of at least Ten (5) acceptable varsity NCAA natural grass installations within the past five (5) years.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 - 1. Report suitability of topsoil for lawn growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in ITB Sections.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
 - 1. Spring Planting: March 15 to May 31
 - 2. Fall Planting: August 15 to October 31
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

- A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
- B. Quality: State-certified seed of grass species that ranks in top ten species according to NTEP ratings.
- C. Sod of grass species as follows, with not less than 95 percent germination, not less than 100 percent pure seed:

1. Base Bid – Sod for Athletic Use
 - a. Athletic Field Mix: Proportioned by weight as follows:
 - 1) 80 percent turf-type tall fescue.
 - 2) 20 percent Kentucky bluegrass.
 - b. Supplier: Green Velvet Sod Farm or approved equal.
 - c. Size: Big roll cut: 250 sq. ft. minimum.
 - d. Cut Thickness: ½ inch.
 - e. Mow Height: Sod to be mown to ½ inch height prior delivery.
2. Bid Alternate – Bluegrass
 - a. Basis of Design: Certified Bluegrass grown by Tuckahoe Turf Farms, Inc., P.O. Box 148, 401 Myrtle Avenue, Hammonton, NJ 08037. Phone: 866-711-2326. Or approved equal.
 - b. Size: Big roll cut: 250 sq. ft. minimum.
 - c. Cut Thickness: ½ inch.
 - d. Mow Height: Sod to be mown to ½ inch height prior delivery.

2.2 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 1. Composition: 10 percent nitrogen, 20 percent phosphorous, and 20 percent potassium, by weight.

2.3 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect grade stakes set by others until directed to remove them.

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

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

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

D. Before planting, obtain Engineer's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SODDING

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

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

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

3.5 TURF RENOVATION

- A. Renovate existing turf where indicated.
- B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - 2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.
- I. Apply initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
 - 1. Initial Fertilizer: Apply according to manufacturer's recommendations.
- J. Apply sod as required for new turf.
- K. Water newly planted areas and keep moist until new turf is established.

3.6 GRADING

- A. Fine-grade subgrade to elevations required to create final finish elevation flush with proposed curb surface. Field to be on uniform plane and grade.
- B. Subgrade: Laser grade the subgrade to a tolerance of + 0.5" of design elevation. Proof-roll the subgrade to assure a consistent and uniform, satisfactory compaction across the entire field. Owner is to be provided with 24 hour notice of proof-roll. Proof-roll to occur in the presence of owner or owner's representative. The Owner, or owner's representative will observe the subgrade and inform the contractor of visual acceptance of the subgrade conditions. Acceptance of the subgrade is required before the contractor can commence drainage installation and/or growing medium placement. The Owner reserves the right to inspect and test the subgrade as it deems appropriate, including employing a certified surveyor or geotechnical engineer. Such acceptance, however, does not relieve the Bidder of responsibility for complying with these specifications.
- C. Drainage: Install drainage according to the plans and specifications and connect the drainage to storm water structures as indicated on the drawings.

- D. Growing Medium: Grade finished surface of gravel base to a tolerance of + 0.5" across the entire field, with variations of less than 0.25" in any 10 lineal feet. Acceptance of the finished grade is required before the contractor can commence sod installation. The Owner reserves the right to independently inspect and test the finished surface, as it deems appropriate, including employing a certified surveyor to assure elevation conformance. Such acceptance, however, does not relieve the Bidder of responsibility for complying with these Specifications.

3.7 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Water via the irrigation system to keep turf uniformly moist to a depth of 4 inches.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - 1. Mow turf to a height of 1-1/4 to 1-1/2 inches.
- D. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry per sod manufacturer's recommendations.

3.8 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Engineer:
 - 1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.9 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.10 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

3.11 MAINTENANCE SERVICE

- A. Initial Lawn Maintenance Service: Provide full maintenance by skilled employees of landscape Installer for lawn areas and sports field Installed for athletic fields. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Sodded Turf: 60 days from date of planting completion.

END OF SECTION 329200

SECTION 334100 - STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and ITB Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
 - 1. Cleanouts.
 - 2. Drains, Catch Basins, Inlets, & Headwalls.
 - 3. Precast concrete & Cast-in-place concrete manholes.

1.3 DEFINITIONS

- A. PE: Polyethylene plastic.
- B. PVC: Polyvinyl chloride plastic.
- C. ODOT: Ohio Department of Transportation

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe.
 - 2. Cleanouts.
 - 3. Trench Drains.
- B. Shop Drawings: For the following:
 - 1. Manholes: Include plans, sections, details, and frames and covers.
 - 2. Catch Basins, Headwalls and Stormwater Inlets. Include plans, sections, details, and frames, covers, and grates.
 - 3. Stormwater Detention Structures: Include plans, sections, details, frames, grates, and covers.

- C. Coordination Drawings: Show pipe sizes, and locations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Profile Drawings (as necessary): Show system piping in elevation view. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and locations of other utilities crossing system piping.

1.6 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, headwalls, and stormwater inlets according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Construction Manager 's permission.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Public Roadway Culverts: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type A Conduits.
- B. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.
- C. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type C Conduits.
- D. Private Drive Pipes and Bikeways: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.

2.2 ALUMINIZED CORRUGATED METAL PIPE AND FITTINGS

- A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.

2.3 PE PIPE AND FITTINGS

- A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.

2.4 PVC PIPE AND FITTINGS

- A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.
- B. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- C. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.5 REINFORCED CONCRETE PIPE AND FITTINGS

- A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.

2.6 DUCTILE IRON PIPE

- A. Per ODOT 748.01 conforming to ANSI/AWWA C151/A21.51, service and extra-heavy classes, for gasketed joints.
- B. Gaskets: ANSI/AWWA C111/A21.11, rubber, compression type, thickness to match class of pipe.

2.7 CLEANOUTS

- A. PVC with cast iron adaptor: Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Include cast iron adaptor and threaded brass closure plug.

2.8 DRAINS

- A. Yard Drains: As noted on the Drawings.
- B. Trench Drains: As noted on the Drawings.

2.9 MANHOLES

- A. Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
 - 1. Diameter: 48 inches minimum, unless otherwise indicated on the drawings.
 - 2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

3. Riser Sections: 4-inch minimum thickness, and of length to provide depth indicated.
4. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings. Steps: ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP; Ductile Iron; or Cast Aluminum. Steps shall be wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Steps shall be equally spaced. Whenever possible steps shall not be placed directly above manhole flow channel. Omit steps if total depth from floor of manhole to finished grade is less than 48 inches.
5. Manhole Frames and Covers: Include lettering cast into cover, using wording equivalent to "STORM SEWER."
 - a. Frames and Covers must be heavy duty

2.10 CONCRETE

- A. General: Cast-in-place concrete according to the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings

2.11 CATCH BASINS

- A. Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
 1. See drawings for schedule of specific types of catch basins
 2. Frames and Grates:
 - a. Are to be heavy duty.
 - b. Are to be ADA compliant.
 - c. Are to be Bicycle safe.

2.12 STORMWATER DETENTION STRUCTURES

- A. As indicated on the Drawings and Per the jurisdiction having authority.

2.13 PIPE INLETS AND OUTLETS

- A. Headwalls: Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Rock Channel Protection (Riprap): Per the latest version of the ODOT Construction and Material Specifications and as indicated on the Drawings.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. General:
 1. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type B Conduits.
 2. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 603.02, Type C Conduits.

- B. Excavation For Utility Trenches:
1. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
 2. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
 3. Excavate trench walls per ODOT Item 603.05 and geotechnical report as identified on the Drawings.
 4. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.
- C. Utility Trench Backfill:
1. Place and compact bedding course as required by ODOT specifications Item 603.06 and geotechnical report. Type 2 bedding consists of structural backfill extending at least 3 inches (75 mm) for all ODOT Item 706 rigid pipe conduits and 6 inches (150 mm) for all other conduits below the bottom of the conduit for the full width of the trench. Extend the bedding up around the pipe for a depth of not less than 30 percent of the rise of the conduit. Shape the bedding to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe. Leave the bedding below the middle one-third of the pipe span uncompacted. Compact the remaining bedding according to ODOT Item 603.11.
 2. Use Type 2 bedding for Types A, B, C, and D conduits except for long span structures and for conduits that require Type 3 bedding.
 3. Type 3 bedding consists of a natural foundation with recesses shaped to receive the bell of bell-and-spigot pipe. Scarify and loosen the middle one-third of the pipe span.
 4. Use Type 3 bedding for Type C and Type D conduits of the following materials: ODOT Items 706.01, 706.02, or 706.03.
 5. Structural backfill for ODOT Item 603 bedding and backfill shall consist of limestone, gravel, natural sand, sand manufactured from stone, or foundry sand. Provide Type I or Type II structural backfill per the requirements of ODOT Item 703.11
 6. Non-structural backfill should consist of clean, inorganic soil free of any miscellaneous materials, cobbles, and boulders. The fill should be placed in uniform, thin lifts and carefully compacted to a unit dry weight equal to 100 percent in structure areas and at least 98 percent of the maximum dry weight below pavement areas. The moisture content of the fill should be maintained at -2 to +1 percent of the optimum moisture content as determined in the laboratory by the Standard Test Methods for Moisture-Density Relations of Soils (ASTM D 698). Fill should not be placed in a frozen condition or upon a frozen subgrade.
 7. Place backfill to the limits described and according to the compaction requirements of ODOT Item 603.11. Place the backfill in the trench and embankment outside the trench uniformly on both sides of the conduit for all conduit installations.
 - a. Type A and B. Backfill Types A and B conduits except for long span structures as follows
 - 1) In a cut situation, place and compact structural backfill above the bedding for the full depth of the trench. Within the trench and more than 4 feet (1.2 m) above the top of the conduit, if the trench can accommodate compaction equipment, the Contractor may construct Item 203 Embankment. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
 - 2) In a fill situation, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and to a depth of 2 feet (0.6 m) above the top of the conduit. Construct the embankment outside the limits of the backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
 - b. Type C and D. Backfill Type C and D conduits as follows:
 - 1) In a cut situation, for plastic pipe, place and compact structural backfill above the bedding and to 12 inches (300 mm) over the top of the pipe. All

other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.

- 2) In a fill situation, for plastic pipe, place and compact structural backfill above the bedding for the full depth of the trench specified in 603.05.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and vertically to the top of the conduit. Then place for a depth of 12 inches (300 mm) structural backfill over the top of the pipe equal to the trench width centered on the pipe center line. Construct the embankment outside the limits of the backfill. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
8. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
9. All fill soils shall be placed in accordance with the article "Compaction of Soil Backfills and Fills" from the Earth Moving Specification Section 312000.
10. Coordinate backfilling with utilities testing.
11. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
12. Place and compact final backfill of satisfactory soil material to final subgrade.

3.2 PIPING INSTALLATION

- A. All installation shall be per the latest version of the ODOT Construction and Material Specifications item 603 and the latest version of the ODOT Standard Construction Drawings.
- B. 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 design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, contact engineer.
- C. 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.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- F. Install gravity-flow, nonpressure drainage piping according to the following:
 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 2. Install piping with 12 inches minimum cover, unless otherwise indicated on the drawings. Notify engineer if less than 12 inches of cover will exist.
 3. During construction protect installed piping from damage. Maintain manufacturers recommended minimum cover.

3.3 PIPE JOINT CONSTRUCTION

- A. All joint construction shall be per the latest version of the ODOT Construction and Material Specifications item 603 and the latest version of the ODOT Standard Construction Drawings.
- B. Join dissimilar pipe materials with pressure-type couplings, or concrete collar.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use medium-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use heavy-duty, top-loading classification cleanouts in paved foot-traffic, vehicle-traffic, roads, and service areas.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in asphalt or concrete pavement with tops flush with pavement surface.

3.5 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
 - 1. Use medium-duty, top-loading classification drains in earth or unpaved foot-traffic areas.
 - 2. Use heavy-duty, top-loading classification drains in paved foot-traffic, vehicle-traffic, roads, and service areas.
- B. Install per manufacturer's written recommendations.

3.6 MANHOLE INSTALLATION

- A. General: Installation shall be per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

3.7 CATCH BASIN INSTALLATION

- A. General: Installation shall be per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Set frames and grates to elevations indicated.

3.8 STORMWATER INLET AND OUTLET INSTALLATION

- A. General: Installation of Headwalls and Rock Channel Protection shall be per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.

3.9 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

3.10 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

3.11 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. 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. Crushed, broken, cracked, or otherwise damaged piping.
 - 2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 3. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
- C. Replace defective piping using new materials, and repeat testing until defect is within allowances specified.

3.12 CLEANING

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

END OF SECTION 334100