

## **SECTION 02200 - EARTHWORK**

### **PART 1 GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. This Section includes the following:
  - 1. Preparing and grading subgrades for slabs-on-grade, walks, pavements, and landscaping.
  - 2. Base course for walks and pavements.
  - 3. Excavating and backfilling for underground mechanical and electrical utilities and appurtenances.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
  - 1. Division 2 Section "Site Clearing" for site stripping, grubbing, topsoil removal, and tree protection.
  - 2. Division 2 Section "Landscaping" for finish grading, including placing and preparing topsoil for lawns and planting.
  - 3. Division 3 Section "Cast-In-Place Concrete" for concrete encasings, cradles, and appurtenances for utility systems.

#### **1.03 DEFINITIONS**

- A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.
- B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- D. Base Course: The layer placed between the subgrade and surface pavement in a paving system.
- E. Drainage Fill: Course of washed granular material supporting slab-on-grade placed to cut off upward capillary flow of pore water.
- F. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect/Engineer. Unauthorized excavation, as well as remedial work directed by the Architect/Engineer, shall be at the Contractor's expense.
- G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- H. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

#### **1.04 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for the following:
  - 1. Each type of plastic warning tape.
  - 2. Filter fabric.
- C. Photographs of existing adjacent structures and site improvements.

#### **1.05 QUALITY ASSURANCE**

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
- B. Testing and Inspection Service: Employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing as required to comply with the specifications.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Management and Coordination."
  - 1. Before commencing earthwork, meet with representatives of the governing authorities, Owner, Architect/Engineer, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

#### **1.06 PROJECT CONDITIONS**

- A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect/Engineer and then only after acceptable temporary utility services have been provided.
  - 1. Provide a minimum 48-hours' notice to the Architect/Engineer and receive written notice to proceed before interrupting any utility.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.

### **PART 2 PRODUCTS**

#### **2.01 SOIL MATERIALS**

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- D. Backfill and Fill Materials: Satisfactory soil materials.

- E. Subbase and Base Material: 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: Subbase or base materials.
- G. Bedding Material: Subbase or base materials with 100 percent passing a 1 inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Fill: Washed, evenly graded mixture of crushed 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 not more than 5 percent passing a No. 8 sieve.
- I. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100 percent passing a 1-1/2 inch sieve and 0 to 5 percent passing a No. 50 sieve.
- J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

## **2.02 ACCESSORIES**

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.
  - 1. Tape Colors: Provide tape colors to utilities as follows:
    - a. Red: Electric.
    - b. Yellow: Gas, oil, steam, and dangerous materials.
    - c. Orange: Telephone and other communications.
    - d. Blue: Water systems.
    - e. Green: Sewer systems.
- C. Filter Fabric: Manufacturer's standard nonwoven pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination.
  - 1. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test method in parentheses:
    - a. Grab Tensile Strength (ASTM D 4632): 100 lb.
    - b. Apparent Opening Size (ASTM D 4751): #100 U.S. Standard sieve.
    - c. Permeability (ASTM D 4491): 150 gallons per minute per sq. ft.

## **PART 3 EXECUTION**

### **3.01 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 subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

- C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- D. Tree protection is specified in the Division 2 Section "Site Clearing."

### **3.02 DEWATERING**

- A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

### **3.03 EXCAVATION**

- A. Explosives: Do not use explosives.
- B. Unclassified Excavation: Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.

### **3.04 STABILITY OF EXCAVATIONS**

- A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.

### **3.05 EXCAVATION FOR STRUCTURES**

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1/2 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and for inspections.
  - 1. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Appurtenances: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1.2 inches. Do not disturb bottom of excavations intended for bearing surface.

### **3.06 EXCAVATION FOR WALKS AND PAVEMENTS**

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

### **3.07 EXCAVATION FOR UTILITY TRENCHES**

- A. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
  - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
  - 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.
  - 1. For pipes or conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
  - 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
  - 3. Where encountering rock or another unyielding bearing surface, carry trench excavation 6

inches below invert elevation to receive bedding course.

### **3.08 APPROVAL OF SUBGRADE**

- A. Notify Architect/Engineer when excavations have reached required subgrade.
- B. When Architect/Engineer determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
  - 1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Architect/Engineer.

### **3.09 UNAUTHORIZED EXCAVATION**

- A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Architect/Engineer.
  - 1. Fill unauthorized excavations under other construction as directed by the Architect/Engineer.

### **3.10 STORAGE OF SOIL MATERIALS**

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

### **3.11 BACKFILL**

- A. Backfill excavations promptly, but not before completing the following:
  - 1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
  - 2. Surveying locations of underground utilities for record documents.
  - 3. Testing, inspecting, and approval of underground utilities.
  - 4. Concrete formwork removal.
  - 5. Removal of trash and debris from excavation.
  - 6. Removal of temporary shoring and bracing, and sheeting.

### **3.12 UTILITY TRENCH BACKFILL**

- A. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Provide 4 inch thick concrete base slab support for piping or conduit less than 30 inches below surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

- C. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
  - 1. 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.
- D. Coordinate backfilling with utilities testing.
- E. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
- F. Place and compact final backfill of satisfactory soil material to final subgrade.
- G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### **3.13 FILL**

- A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
  - 1. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.
- B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.
- C. Place fill material in layers to required elevations for each location listed below.
  - 1. Under grass, use satisfactory excavated or borrow soil material.
  - 2. Under walks and pavements, use subbase or base material, or satisfactory excavated or borrow soil material.
  - 3. Under steps and ramps, use subbase material.
  - 4. Under building slabs, use drainage fill material.
  - 5. Under footings and foundations, use engineered fill.

### **3.14 MOISTURE CONTROL**

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

### **3.15 COMPACTION**

- A. Place backfill and fill materials in layers not more than 6 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 materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.
- C. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, compact the top 12 inches below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
2. Under walkways, compact the top 6 inches below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
3. Under lawn or unpaved areas, compact the top 6 inches below subgrade and each layer of backfill or fill material at 90 percent maximum dry density.

### **3.16 GRADING**

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  1. Provide a smooth transition between existing adjacent grades and new grades.
  2. Cut out soft spots, fill low spots, and trim high spots to conform to 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. Lawn or Unpaved Areas: Plus or minus 1 inch.
  2. Walks: Plus or minus 1/2 inch.
  3. Pavements: Plus or minus 1/2 inch.

### **3.17 SUBBASE AND BASE COURSES**

- A. Under pavements and walks, place subbase course material on prepared subgrades. Place base course material over subbases to pavements.
  1. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 95 percent of ASTM D 4254 relative density.
  2. Shape subbase and base to required crown elevations and cross-slope grades.
  3. When thickness of compacted subbase or base course is 6 inches or less, place materials in a single layer.
  4. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

### **3.18 FIELD QUALITY CONTROL**

- A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
  1. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.
    - a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.

- b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect/Engineer.
  - 2. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
  - 3. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.
- B. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.

### **3.19 PROTECTION**

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
  - 1. Scarify or remove and replace material to depth directed by the Architect/Engineer; reshape and recompact at optimum moisture content to the required density.
- C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

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

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

**END OF SECTION 02200**