

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Excavation, filling, compacting and grading in the areas shown on the drawings to obtain the required finished ground surface properly prepared to receive pavements, walks, building floor slabs, utilities, and drainage structures.
2. Ditching in soil areas of high moisture content to allow the soil to drain prior to making excavations.
3. Adjustment of moisture content up or down by discing of soils placed in fills if soil tests show drying to be necessary to meet compaction requirements.
4. Spreading topsoil in sufficient quantities to backfill islands, medians, and roadway shoulders and open graded areas.
5. Undercutting unsuitable soil materials and replacing with compacted approved soils.
6. Stockpiling approved soil material in convenient location and in sufficient quantity for use in backfill of walls.
7. Removal from the job of unsuitable, excess materials.
8. Importing material, if required, from offsite.
9. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
10. Excavating and backfilling.
11. Drainage course for concrete slabs-on-grade.
12. Subbase course for concrete walks and pavements.
13. Subbase and base courses for asphalt paving.
14. Subsurface drainage backfill for walls and trenches.

1.3 UNIT PRICES

- A. Work of this Section may be affected by unit prices for earth moving.
- B. Rock Excavation Volume: Volume of rock actually removed, measured in original position, but not to exceed the following measurements. Unit prices for rock excavation include replacement with approved materials.
 1. Measure Rock Excavation volume as follows:
 - a. Mass Rock:
 1. Quantity of rock excavation will be established from cross sections taken by a representative chosen by the Owner. Prior to any rock excavation, expose the rock to be removed which has not been cross sectioned by the Owner's representative or no payment will be made. Prior to payment for rock excavation, the Owner's representative will prepare final cross sections and verify that the rock has been removed to the proper elevation.
 2. Rock removed before measurement will not receive compensation.

3. Calculate the quantity of rock using the following limits:
 - a. Top of rock;
 - b. To 6" below bottom of base course and 12" beyond edge of paving for uncurbed paved areas;
 - c. To vertical line one foot behind back of curb;
 - d. To 6" below foundations and footings;
 - e. To vertical faces located 12" horizontal distance from each footing or foundation face;
 - f. To 6" below bottom of slabs on grade;
 - g. To finish grade in cut where rock is removed to finish grade. Where it is not so removed, to the finish rock surface.
 - h. To 12" outside forms for concrete work requiring forms.
 - i. To neat outside dimensions for concrete work with no forms.
- b. Trench Rock:
 1. Measure trench rock by taking level reading at reasonable intervals but not more than ten feet along the exposed trench length before removal of rock.
 2. Rock removed before measurement will not receive compensation.
 3. Calculate the quantity of rock using the following limits:
 - a. Top of rock;
 - b. To vertical faces 12" beyond the outside of pipe barrel, each side;
 - c. To 6" below the pipe barrel for the full trench width;
 - d. To vertical faces 12" horizontal distance beyond structures and manholes;
 - e. To 6" below bottom of slab for structures.
- C. Include in the bid submittal unit costs to purchase and place or perform as specified on the jobsite the following items:
 1. Surge stone, Type 1 and Type 3 rip-rap (per ton placed)
 2. #57 stone (per ton placed)
 3. Graded Aggregate Base, GAB (per ton placed)
 4. Geotextile fabric, Mirafi 500 X or equivalent (stabilization) (per sq.ft. installed)
 5. Rock excavation and backfill complete (mass) (per cu.yd.)
 6. Rock excavation and backfill complete (trench) (per cu.yd.)

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subgrade and hot-mix asphalt paving, concrete paving or walks.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

- D. Borrow Soil: Suitable soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.
- G. Fill:
 - 1. Structural Fill is defined as fill supporting retaining wall footings or any structure whatsoever and extending for a distance of ten feet (10') on each side of said structure measured at the finished grade, thereafter tapering away at a 45-degree angle.
 - 2. Paving Area Fill is defined as fill supporting any asphalt, concrete paving, or special paving for parking of cars, or trucks, or concrete walks and extending for a distance of five feet (5') on each side of said area measured at the finished grade, thereafter tapering away at a 45-degree angle.
 - 3. General Area Fill is defined as fill in the general grading area covering banks, lawns, hollows, drainage ditches.
- H. "General earth excavation" is defined as follows:
 - 1. Materials regardless of its nature or composition that can be removed by scrapers, loaders, pans, dozers, backhoes, or graders up to and including that material which requires the use of a single tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated not less than 80,000 pounds. Boulders & Partially Weathered Rock as defined in the geotechnical report are included.
- I. "Mass rock" as used herein is defined as follows:
 - 1. Material which cannot be excavated except by drilling or blasting;
 - 2. Material which is hard enough to ring when struck with a hammer, and the amount is greater than one (1) cubic yard of solid stone in volume; and
 - 3. Any material that cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated no less than 80,000 pounds (Caterpillar D-8 or equivalent) and having an original volume of at least one (1) cubic yard.
- J. "Trench rock" is defined as follows:
 - 1. Material which occurs in a utility trench;
 - 2. Material which is greater than 2 cubic yards in volume; and
 - 3. Any material that cannot be excavated with a large backhoe having a curling force of no less than 40,000 pounds (John Deer or equivalent) and having an original volume of at least one-half (1/2) cubic yard.

- K. "Muck" is defined as highly organic or plastic material which cannot support fill, footings, slabs, and pavements and requires removal by power shovels or draglines. Excessively wet or dry materials are not considered unsuitable.
- L. 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.
- M. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below base course, drainage fill, drainage course, or topsoil materials.
- N. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- P. Protection zones: Areas that include undisturbed buffers, tree protection zones, rights of way, wetlands, state waters, utility easements, adjacent properties and any other environmental sensitive areas.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site. At minimum, Owner, General Contractor, Site Contractor, Testing Agency and Local Inspector should be in attendance.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required, if requested:
 - 1. Geotextiles.
 - 2. Controlled low-strength material, including design mixture.
 - 3. Warning tapes.
- B. Samples for Verification: For the following, in sizes indicated below, if requested provide to Geotechnical Engineer:
 - 1. Geotextile: 12 by 12 inches.
 - 2. Warning Tape: 12 inches long; of each color.
 - 3. Fifty pound sample of each class fill material encountered as directed by the Geotechnical Engineer using care that samples are representative.
 - 4. Fifty pound sample of proposed offsite source fill material.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill.
- C. Blasting plan approved by authorities having jurisdiction.
- D. Seismic survey report from seismic survey agency.
- E. Classification according to ASTM D 2487.
- F. Laboratory compaction curve according to ASTM D 698.

- G. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction property site improvements and downstream bodies of water including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.
- H. Submit certification by a Geotechnical Engineer to the Owner that materials imported to the site meet the definition of suitable soils and contain no hazardous substances.

1.8 QUALITY ASSURANCE

- A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Material Code," and prepare a blasting plan reporting the following:
 - 1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services.
 - 1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- D. Soils Report:
 - 1. Obtain a copy of available reports and become familiar with their contents. The Owner makes no assurances as to the contents of the reports. Any claims based on the contents of the reports are disallowed.
- E. Adjacent to buildings and in parking lots and roads, grade to within five hundredths (5/100) of a foot of the elevations and contours shown on the Drawings. In open areas, grade to within one-tenth (1/10) of a foot of those shown on the Drawings. Hand dress grades under buildings, slabs, walks, and steps to obtain the required elevation as shown on the Drawings.
- F. Perform no unauthorized or unnecessary grading. This consists of removal of materials beyond the plan limits of grading and removal of materials beyond indicated subgrade elevation or dimensions without specific direction of the Owner's representative. Provide necessary remedial work at no cost to the Owner.

1.9 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and Local Authority Having Jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or Authority Having Jurisdiction.
- B. Improvements on Adjoining Property: Confirm Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
1. Do not proceed with work on adjoining property until directed by Owner.
- C. Utility Locator Service: Notify utility locator service for area where Project is located no less than 10 days before beginning earth moving operations. Notify Engineer of Record and cease work if any utilities located in the field differ from locations provided in project survey.
- D. Do not commence earth moving operations until initial erosion and sedimentation control measures and plant protection measures are in place and 7 day letter has been issued.
- E. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging.
 7. Attachment of signs to or wrapping materials around trees or plants.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

1.10 MODULAR RETAINING WALLS

- A. Design, construct, test, guarantee, and warrant modular unit retaining walls under the complete and total responsibility of a single entity.
- B. Submit to the Owner with the BID a complete design for the walls, including plan view, sections, and elevations, sealed by a registered Structural Engineer licensed to practice in the project jurisdiction. Submit stamped calculations supporting the design, based on wall specific geotechnical information obtained under the direction of the wall design engineer of record.
- C. Where walls are installed in cut slopes give particular attention to adequate drainage systems designed to relieve hydrostatic pressure accumulation behind the walls.
- D. Submit color and unit type for Owner approval.
- E. Warrant the walls and indemnify the Owner against liability related to the design, testing, installation and performance of the walls.

- F. Retain the services of a Geotechnical Engineer and submit certified documentation that the soils encountered are consistent with soil values and all testing requirements used in the wall design. Meet manufacturer's requirements for soils testing.
- G. Construction trailers, batch plants, fueling stations, and all other construction related structures, vehicles and materials must be located outside of public or privately owned rights-of-way and within the project limits of construction.

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient suitable soil materials are not available from excavations.
- B. Suitable Soils: Soil Classification Groups GW, GP, GM, SW, SP, ML, CL, SC and SM according to ASTM D 2487, or a combination of these groups approved by the Geotechnical Engineering testing agency; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, organics, and other deleterious matter.
 - 1. Use soils for structural backfill having a minimum dry density of 97 pounds per cubic foot unless otherwise approved by the Geotechnical Engineer.
- C. Unsuitable Soils: Soil Classification Groups GC, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups, unless approved for use by the Geotechnical Engineer.
 - 1. Existing undisturbed soils which are determined by the Geotechnical Engineer or Design Professional to be unsuitable for use as fill, in a particular application, for reasons other than moisture or water content.
 - a. Water saturated soils, regardless of the source of water (rainfall, storm runoff, ground water or other sources) shall not be considered unsuitable.
 - b. Unsuitable soil quantities will be determined by the Geotechnical Engineer by measuring in-place quantities.
- D. 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. 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 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 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.

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; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf ; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf ; ASTM D 4632.
4. Tear Strength: 56 lbf ; ASTM D 4533.
5. Puncture Strength: 56 lbf ; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf ; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf ; ASTM D 4632.
4. Tear Strength: 90 lbf ; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150, Type I.
2. Fly Ash: ASTM C 618, Class C or F.
3. Normal-Weight Aggregate: ASTM C 33, 3/4-inch nominal maximum aggregate size.
4. Foaming Agent: ASTM C 869.
5. Water: ASTM C 94.
6. Air-Entraining Admixture: ASTM C 260.

- B. Produce low-density, controlled low-strength material with the following physical properties:

1. As-Cast Unit Weight: 30 lb/cu. ft. minimum at point of placement, when tested according to ASTM C 138.
2. Compressive Strength: 80 psi, when tested according to ASTM C 495.

- C. Produce conventional-weight, controlled low-strength material with 80-psi compressive strength when tested according to ASTM C 495.

2.4 MODULAR UNIT RETAINING WALLS

- A. Use units of standard quality, free of chips and cracks, and consistent in color and tone chosen by Owner.
- B. Remove defective units from the site.

2.5 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- D. Protection of Existing Trees Remaining:
 - 1. Protect tops, trunks, and roots of trees to remain; box, fence or otherwise protect trees which are subject to site work or construction damage. See the Section SITE CLEARING for tree protection and removal of any interfering branches. Immediately and properly trim and paint with a protective tree wound and sealing compound any cuts, or accidental injury to the bark or trunk. Remove protection only when danger from operations no longer exists.
- E. Protection of Adjacent Property:
 - 1. For the duration of the construction and until release, protect adjoining property from any excessive drainage and debris. Do not enter upon adjoining property without the permission of the property owner.

3.2 DEWATERING

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

3.3 EXPLOSIVES

- A. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to project site or using explosives on Project site.
 - 1. Perform blasting without damaging adjacent structures, property, or site improvements.
 - 2. Perform blasting without weakening the bearing capacity of rock subgrade and with the minimal disturbance of rock to remain.

3.4 PROCEDURES

- A. After clearing and disposal is complete, strip from the top of the existing ground topsoil in all areas to be graded. Stockpile in approved locations where it will not interfere with building or utility operations. Use topsoil free from subsoil, debris and stones larger than 2" in diameter. Locate stockpiles as designated by the Owner. At the completion of the work, distribute topsoil over the grounds to form a minimum cover of 4 inches loose measure on graded areas to receive vegetation and other areas indicated by the Owner. Scarify subgrade prior to spreading topsoil. Form berms as directed to dispose of excess topsoil and haul off topsoil remaining. Import topsoil to meet the minimum coverage if onsite topsoil is insufficient.
- B. Perform exterior grading in accordance with the drawings to ensure minimum 2% slope away from building in all directions.
- C. Graded Areas: Repair and reestablish grades to the required elevations and slopes if any settlement or washing occurs prior to the acceptance of the work. Fill to required subgrade levels any areas where settlement occurs.
- D. Temporary Grading and Drainage: Provide additional temporary drainage measures to prevent ponding and maintain effective drainage for the entire site through all phases of construction.
- E. Excavating: Make no footing excavations to the full depth indicated when freezing temperatures or rain is expected. When full depths are reached, protect bottoms from frost or rain if placing of concrete is delayed.
 - 1. Excavate material of every description and whatever substance encountered, to dimensions and levels shown on the Drawings. Excavate work to be clean-cut and true with bottoms level and sound.
 - 2. Lab Testing: The Geotechnical Engineer will make necessary tests for required soil bearing values, and soil compaction.

3. Existing Site Conditions: Excavate any existing depressions or trenches that are encountered and are entirely within the new building walls, or within 5 feet of walls, to solid sub-grade and fill with compacted gravel or concrete to underside of new foundation or floor slab.
4. Unsuitable Bearing Material: Place the bottom of trenches, foundations and footings and base for paving on compacted suitable material. Remove loose materials, surface vegetation, debris and existing fill before any fill is placed. Proof roll the subgrade in the presence of the Geotechnical Engineer. Fill operations can then take place. Do not place footings until the Geotechnical Engineer and the Owner have examined and approved the soil upon which they will rest. If the bearing capacity at the levels indicated are found by the Testing Laboratory to be insufficient, the Owner may order the excavations carried to proper bearing capacity. Provide a minimum of twelve (12) inches compacted graded aggregate base stone between bottom of footings and any rock encountered. Compact fill in accordance with requirements for backfill.
5. Extend excavation to the depths and dimensions required by the drawings, including removal of rock.

3.5 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials include rock, trash, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for conditions encountered.
 1. If excavated materials intended for fill and backfill include unsuitable soil materials and rock, replace with suitable soil materials.
 2. Remove rock to lines and grades to permit installation of permanent construction to dimensions required for rock excavation measurement and payment is a minimum.
- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and measured. The Contract Sum will be adjusted for rock excavation according to the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation will be considered earth excavation.
 2. Rock excavation includes removal and disposal of rock. Measure rock excavation for payment to lines and subgrade elevations indicated to permit installation of permanent construction.

3.6 ROCK EXCAVATION

- A. When rock is encountered, clear away earth and notify the Owner. Owner will inspect material and issue written instructions. Do not excavate rock without written instructions.
- B. Blast in accordance with local ordinances, and obtain permits where required by law. Complete blasting before any building footing is poured.

- C. Remove excavated rock from the site or bury as directed by the Geotechnical Engineer, if allowed.
- D. Excavated or blast rock is not allowed to be used for rip-rap or erosion control BMPs. Meet the specifications for rip-rap.
- E. Excavate rock to below bottom of building slabs and footing, pavement, and piping to dimensions specified for measurement as a minimum.

3.7 EXCAVATION FOR MUCK

- A. When muck is encountered, notify Owner immediately. The Owner or Geotechnical Engineer will inspect the material and issue written instructions.
- B. Quantity of muck will be established from taking level reading by a representative chosen by the Owner or Geotechnical Engineer. Take the readings at reasonable intervals to identify the contours of the area, including the existing condition and the final excavated condition.
- C. Muck removed before measurement will not receive compensation.
- D. Calculate the quantity of muck by making surveys before and after removal. Base payment on the quantity of muck removed as calculated using the surveys.
- E. Stockpile muck on site and reuse as allowed by the Geotechnical Engineer. Remove material which is not reused from the site. Provide settling ponds, dikes, piping, and appurtenances to prevent stockpile runoff from discoloring nearby streams.

3.8 EXCAVATION EMBANKMENT AND BRACING

- A. Accept full responsibility for excavations. Protect excavation embankments against collapse. Where possible, make embankments over 5'-0" high at a slope not greater than 2:1 unless a steeper slope is recommended by a Registered Geotechnical Engineer.
- B. Where it is not possible to provide a safe environment for slopes, temporarily support banks and maintain securely until permanent support has been provided.
- C. Provide cross bracing and shoring to prevent collapse, where ditches or trenches are over 5'-0" deep.
- D. Provide bracing system drawings designed and sealed by a Registered Engineer experienced in such designs. Use these design drawings to show the work and sequence in its entirety and submit to the Owner prior to commencing the work.
- E. To prevent caving or settlement of earth adjacent to excavations, and for the protection of persons as well as property, provide shoring, bracing, and other similar material to meet the conditions in each particular case encountered. Leave in place until construction has reached a point where backfills behind walls or in ditches have been made and the need for shoring and bracing has been eliminated.

3.9 FOUNDATION BEARING TEST

- A. The Geotechnical Testing Lab shall inspect the bearing surface prior to the contractor placing reinforcing steel/concrete.

3.10 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 placement and removal of concrete formwork for inspections, and for installation and other construction.
 - 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.
 - 2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 - 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 - 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots. Protect any exposed roots.

3.11 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.12 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. All utility trenches must have clearances provided of 12 inches each side of pipe or conduit.
 - 2. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide 12 inches 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.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. All utility trenches must have bedding provided that meets the requirements of the local jurisdiction and the geotechnical engineer's recommendations.
2. Excavate trenches to an elevation required in rock or other unyielding bearing material to allow for bedding course as directed by geotechnical engineer.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Protect any exposed roots.

3.13 EXCAVATION FOR ELEVATOR CYLINDER

- A. Drill well hole plumb in elevator pit to accommodate installation of elevator-cylinder assembly. Coordinate with applicable requirements for diameter and tolerances in Division 14.
- B. Provide well casing as necessary to retain walls of well hole.

3.14 SUBGRADE INSPECTION

- A. Notify Owner when excavations have reached required subgrade.
- B. If Geotechnical Testing Agency determines that unsuitable soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proofrolling
 1. Contact the Owner's representative and the Geotechnical Engineer at least 48 hours in advance of proofrolling.
 2. Clear and strip as herein specified areas to receive controlled structural and paving area fill. After removal of existing structures and topsoil, and before placement of any structural and paving area fill, proofroll that portion of the footing area and paved areas to receive fill to a distance of ten feet (10') beyond the limits. Accomplish proofrolling with a loaded twenty (20) ton minimum dump truck with two (2) complete coverages in each of two (2) perpendicular directions unless otherwise allowed. Accomplish proofrolling under the observation of the Geotechnical Engineer.
 3. For any areas that "pump" under the wheels of the loaded truck, follow remediation measures as directed by the Geotechnical Engineer.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Testing Agency, without additional compensation.

3.15 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. Concrete fill to be used if approved by Geotechnical Engineer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Owner and the Geotechnical Engineer.

3.16 ADDED EXCAVATIONS

- A. Should the bearings at the levels indicated be found by the Geotechnical Engineer to be insufficient, the Owner may order the excavations carried to proper bearing or implementation of additional remedial work as recommended by the Geotechnical Engineer.

3.17 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated suitable 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.

3.18 FILLING AND BACKFILL

- A. Provide grading required for subgrade, under floor slabs, paved walks, drives, parking areas and against walls. Construct fills as herein specified.
- B. Clear and grub vegetation from areas to be filled. Scarify the ground to insure bond between the fill and the original surface. For fill to be placed on hillsides, plow deeply or, where existing ground is steeper than 3:1 or as directed by Geotechnical Report, bench the existing ground surface before beginning the filling operations.
- C. Place fill material in uniform, horizontal layers as indicated in Geotechnical Report. Moisten each layer as necessary to insure a proper bond and maximum compaction. Use suitable equipment to mix the material and insure uniform moisture content. Fully and uniformly compact each layer with a sheep's foot roller or vibratory roller of the proper size and weight to achieve specification.
- D. Fill slopes in excess of 20' of vertical height should include a minimum 5' slope bench for every 15'-20' of vertical on the slope, and the slope should not be steeper than 2:1 or a global stabilization analysis must be provided by a licensed structural engineer.

3.19 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.
- 3.20 BACKFILL AGAINST FOUNDATION WALLS, IN TRENCHES AND EXCAVATIONS, AND OTHER NECESSARY LOCATIONS
- A. Do not place backfill against foundation walls until foundation walls are braced and have cured sufficiently to develop the strength necessary to withstand, without damage, the pressures that will result from backfilling and compacting operations. Secure approval of the Geotechnical Engineer before commencing backfilling.
 - B. Placing Backfill: Place backfill material in uniform, approximately horizontal layers, not exceeding recommendation from Geotechnical Engineer. Compact each layer with pneumatic tampers or sheepsfoot roller to optimum moisture to produce a minimum of 95% of the standard proctor maximum dry density (ASTM D-698), with the upper 12" compacted to 98%. Coordinate with the Geotechnical Engineer to perform tests of fill density in place for every lift. Submit reports of tests to the Owner.
 - C. Surplus Materials: Dispose of excess or unsuitable materials.
- 3.21 UTILITY TRENCH BACKFILL
- A. Place backfill on subgrades free of mud, frost, snow, or ice.
 - B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
 - C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings as directed by Geotechnical Engineer; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03.
 - D. Shallow Trenches under Roadways: Unless indicated by Local Jurisdiction, 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 course. Concrete is specified in Division 03.
 - E. Backfill voids with suitable soil while removing shoring and bracing.
 - F. Place and compact initial backfill of subbase material or suitable soil, free of particles larger than 2 inches in any dimension, to a height of 12 inches over the pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
 - G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Place final backfill of controlled low-strength material to final subgrade elevation. Coordinate backfilling with utilities testing.
 - H. Place and compact final backfill of suitable soil to final subgrade elevation.

- I. Install warning tape directly above utilities, 18 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.22 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 1. Under grass and planted areas, use suitable soil material.
 2. Under walks and pavements, use suitable soil.
 3. Under steps and ramps, use suitable soil.
 4. Under building slabs, use suitable soil.
 5. Under footings and foundations, use suitable soil.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.23 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 3 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 suitable soil material that exceeds optimum moisture content by 3 percent and is too wet to compact to specified dry unit weight.

3.24 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, or as directed by Geotechnical Engineer.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 1. Under structures, building slabs, steps, and pavements, scarify and re-compact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent, with the upper 12 inches compacted to 98 percent.
 2. Under walkways, scarify and re-compact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent, with the upper 12 inches compacted to 98%.
 3. Under turf or unpaved areas, scarify and re-compact top 6 inches below subgrade and compact each layer of backfill or fill soil material to 90 percent.
 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.25 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 Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within 1/10th of a foot of design elevation.
- C. Grading:
 - 1. Place fill as specified for backfill except as noted herein. Accomplish compaction by traversing with a sheepsfoot roller or other approved heavy grading machinery. Compact fill to a minimum of 95% of the standard proctor maximum dry density (ASTM specifications D-698) to 12 inches below subgrade for structural fill areas for a minimum distance of ten feet outside of structure perimeter and for locations for future buildings. Compact parking area fill soils to 95% of the soil's standard density to 12 inches below subgrade. Compact general fill areas to 90% of the standard density.
 - 2. Compact the upper 12 inches of fill in structural fill areas and paving areas to 98% standard proctor density.
 - 3. Preparation of sub-grade for slabs: Remove roots and debris subject to termite attack, rot or corrosion and other material not suitable for fill. Fill holes and minor depressions and compact fillings as specified herein including re-compaction of sub-grade. Place subgrade soils within +/-3% of the soils optimum moisture content per ASTM 698, contain no deleterious material and no rock fragments over 2" (inches) in diameter.

3.26 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 33.
- B. Subsurface Drain: Place subsurface drainage geotextile material 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 6 inches of filter material, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 9 inches.
 - 1. Compact each filter material layer with a minimum of two passes of a plate-type vibratory compactor.
- 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 one layer of subsurface drainage geotextile, overlapping sides and ends at least 9 inches.
 - 1. Compact each filter material layer with a minimum of two passes of a plate-type vibratory compactor.

2. Place and compact fill over drainage backfill in 6-inch thick compacted layers to final subgrade or as indicated by Geotechnical Engineer.

3.27 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 1. Where specified, install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place base course material over subbase course under hot-mix asphalt pavement.
 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
 4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer, or as indicated by Geotechnical Engineer.
 5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick, or as indicated by Geotechnical Engineer.
 6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 698, or as indicated by Geotechnical Engineer.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of suitable soil materials and compact simultaneously with each subbase and base layer to not less than 98 percent of maximum dry unit weight according to ASTM D 1557.

3.28 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- 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. Where specified, 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 95 percent of maximum dry unit weight according to ASTM D 698.

3.29 MODULAR UNIT RETAINING WALLS

- A. See Section 323223
- B. Construct walls to clean, straight horizontal and vertical lines in accordance with manufacturer's instructions.

- C. Place backfill to meet design specifications.
- D. Submit sufficient documentation by the modular Wall Geotechnical Engineer to show that construction conditions are consistent with design parameters for soils.
- E. Mix units to minimize color tone variations in the wall. The Owner may require reconstruction of wall sections where noticeable color variation occurs due to lack of or inappropriate mixing.

3.30 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and observations during Earthmoving operations.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Structural Fill and Paving Area Fill: At subgrade and at each two feet of compacted fill and backfill, at least one test for every 5,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each two feet of compacted backfill layer, at least one test for every 50 feet or less of wall length, but no fewer than two tests.
 - 3. Trench Backfill: At each two feet of compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.
 - 4. General Area Fill: At each two feet of compacted fill layout for every 10,000 sq.ft. of area.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; re-compact and retest until specified compaction is obtained, at no cost to the Owner. Contractor to pay for all failed tests.

3.31 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 Owner or Geotechnical Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing under guidance of the Geotechnical Engineer.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.32 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus suitable soil and waste materials, including unsuitable soil, trash, and debris, and legally dispose of them off Owner's property, unless otherwise directed by the Owner. Acquire all necessary permits.
- B. During the construction and clean-up, do not dump debris on any part of the property or in any unauthorized place. Remove debris, construction material, equipment, logs, stumps, boulders, or any other extraneous material deposited during construction from the site. Remove existing debris or other extraneous material from undisturbed areas. Material that is removed from the site is the property of the Contractor.

END OF SECTION 312000