

SECTION 02315

EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Common Excavation, stockpile subsoil for later reuse. Remove excess from site.
- C. Grade and rough contour site.
- D. Prepare subsoil and borrow to receive subbase and base gravels and topsoil materials.
- E. Fill materials
- F. Aggregate base and subbase gravels for pavement areas
- G. Preparation of foundation bearing surfaces.
- H. Place, grade and compact subbase and base gravels to receive pavement.
- I. Compaction requirements.
- J. Dust Control.
- K. The following soils report, boring logs, supplemental reports, letters, etc. are included and hereby made a part of these specifications. Construct project in accordance with the recommendations contained in these reports. All references in the construction documents to "Geotechnical Report" or "Soils Report" are to the following:
 - 1. "Explorations and Geotechnical Services, _____" prepared by S.W. Cole Engineering, Inc. of Gray, Maine and _____. Data on the indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. Additional test borings and other exploratory operations may be made by the Contractor for the purpose of preparing his bid but these will be at no cost to the Owner.

1.02 RELATED SECTIONS

- A. Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 02250 - Dewatering.
- C. Section 02317 - Trenching for Site Utilities.
- D. Section 02320 - Slope Protection and Erosion Control.
- E. Section 02741 - Bituminous Concrete Paving.

1.03 REFERENCES

- A. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 1996a.
- B. ASTM D 698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 1991.
- C. ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 1991.

- D. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System); 1998.
- E. .ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 1996.
- F. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 1996.
- G. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 1998.
- H. State of Maine Department of Transportation, Standard Specifications, latest edition (Maine DOT Specifications).

1.04 DEFINITIONS

- A. Common Excavation: Excavated material meeting the description of Maine DOT Specifications Section 203.01, except common excavation shall include the removal and disposal of boulders, solid mortared stone masonry, and concrete masonry when each is less than 2 cubic yards in volume.
- B. Earth excavation includes excavation of pavements and obstructions visible on ground surface; underground structures, utilities and other items indicated to be demolished and removed; together with earth and other materials encountered.

1.05 SUBMITTALS

- A. Samples: 75 pound sample of each type of fill and aggregate material; submit in air-tight containers to testing laboratory.
- B. Materials Sources: Submit name of imported materials source.
- C. Fill Composition Test Reports: Results of laboratory gradation tests on proposed and actual materials used.
- D. Moisture Density Test Reports: Results of ASTM D 1557 laboratory tests. Verify soil/fill-bearing capacity conforms to design requirements. Perform on test at each column pad and per each 50 linear feet of foundation.
- E. Field density tests, Perform at least one test per each 2,500 sq. ft. per lift or fill
- F. Trench Backfill: Perform at least one test per each 100 lineal feet of trench. Recompact and retest density and compaction of any trench installed after building pad testing has been performed.
- G. Foundation wall backfill inside and outside shall have compaction tests made every 50 linear feet. Tests shall be performed on each 12 inch lift.
- H. Perform one test per each type soil and each 1,000 cubic yards of material.
- I. Final building pad verification letter, submitted by the Geotechnical Engineer at the completion of grading operations, summarizing satisfactory completion of all tests performed prior to slab placement.

1.06 PROJECT CONDITIONS

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Protect plants, lawns, and other features to remain.

- C. bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- D. Protect above or below grade utilities which are to remain.
- E. Underpin adjacent structures which may be damaged by excavation work, including service utilities and pipe chases.
- F. Notify Owner of unexpected subsurface conditions and discontinue work in affected area until notification to resume work.
- G. Protect excavations and soil adjacent to and beneath foundations from frost.
- H. Grade excavation top perimeter to prevent surface water runoff into excavations.
- I. Protect excavations by shoring, bracing, sheet piling, underpinning or other methods required to prevent cave-in or loose soil from falling into excavation.
- J. Maintenance of existing flows:
 - 1. Keep existing sewers and drains in operation.
 - 2. If existing sewers and drains are disturbed, provide for maintenance of such flows until work is completed.
 - 3. Do not allow raw sewage to flow on ground surface or stand in excavation.
- K. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- L. When fill materials need to be stored on site, locate stockpiles where indicated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.
 - 4. Limit stockpile heights so as to preclude ground failure.
- M. The Contractor will be responsible for obtaining any necessary street opening permits from the City of Portland, and complying with the terms and conditions of said permit.

PART 2 PRODUCTS - NOT USED

2.01 MATERIALS

- A. Subsoil: Reused, meeting the requirements of Granular Borrow or as Common Borrow, provided they comply with the specifications below.
- B. Common Borrow: Maine DOT Section 703.18; Shall consist of inorganic mineral soil free of ice, loam, organic or other unsuitable material, with sufficient moisture content to provide the required compaction, moisture content shall not exceed 4 percent above optimum. Determine optimum moisture content in accordance with ASTM D 698 (Cohesive Soils) or D 1557 (Granular Soils).
- C. Granular Borrow: Maine DOT 703.19; Mixture of sand, gravel and silt or reclaimed asphalt, concrete, brick, crushed rock that is crushed and blended with sand, free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of that portion passing a 2 inch sieve shall meet the following requirements:
 - 1. No. 40 sieve: 0 to 70 percent passing by weight.
 - 2. No. 200 sieve: 0 to 20 percent passing by weight.
 - 3. Granular borrow shall contain no particles or fragments with a maximum dimension in excess of one-half of the compacted thickness of the layer being placed. Granular borrow shall not contain particles of rock which will not pass the 6 inch square mesh sieve.

- D. Aggregate Base: Maine DOT Section 703.06 Type 'A' Crushed Gravel, of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of that part that passes a 3 inch sieve shall meet the following requirements:
 - 1. 1/2 inch sieve: 45 to 70 percent passing by weight
 - 2. 1/4 inch sieve: 30 to 55 percent passing by weight
 - 3. No. 40 sieve: 0 to 20 percent passing by weight
 - 4. No. 200 sieve: 0 to 5 percent passing by weight
 - 5. Type A aggregate shall not contain particles of rock which will not pass the 2 inch square mesh sieve.

- E. Aggregate Subbase: Maine DOT Section 703.06, Type 'D' Gravel, of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of that part that passes a 3 inch sieve shall meet the following requirements:
 - 1. 1/4 inch sieve: 25 to 70 percent passing by weight
 - 2. No. 40 sieve: 0 to 30 percent passing by weight
 - 3. No. 200 sieve: 0 to 7 percent passing by weight.
 - 4. Type D aggregate shall not contain particles of rock which will not pass the 6 inch square mesh sieve.

- F. Structural Fill: Clean, non-frost susceptible, sand, screened or crushed gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation shall meet the following requirements:
 - 1. 4 inch sieve: 100 percent passing by weight.
 - 2. 3 inch sieve: 90 to 100 percent passing by weight.
 - 3. 1/4 inch sieve: 25 to 90 percent passing by weight.
 - 4. No. 40 sieve: 0 to 30 percent passing by weight.
 - 5. No. 200 sieve: 0 to 5 percent passing by weight.

- G. Crushed Stone: Maine DOT Section 703.22 Underdrain backfill Type 'C' meeting the following requirements:
 - 1. 1 inch sieve: 100 percent passing by weight.
 - 2. 3/4 inch sieve: 90 to 100 percent passing by weight.
 - 3. 3/8 inch sieve: 0 to 75 percent passing by weight.
 - 4. No. 4 sieve: 0 to 25 percent passing by weight.
 - 5. No. 10 sieve: 0 to 5 percent passing by weight.

2.02 ACCESSORIES

- A. Water for sprinkling: Fresh and free from oil, acid, and injurious alkali or vegetable matter.
- B. Woven Geotextile Fabric: Non-Biodegradable, Mirafi 500x or approved equivalent.
- C. Non-woven Geotextile Fabric: Non-Biodegradable, Mirafi 160N or approved equivalent.
- D. Calcium chloride: ASTM D 98 commercial grade except as waived by Owner.

2.03 SOURCE QUALITY CONTROL

- A. Where fill materials are specified by reference to a specific standard, test and analyses samples for compliance before delivery to site.
- B. If tests indicate materials do not meet specified requirements, change material and retest. Materials failing to meet specified requirements, if used prior to acceptance, shall be removed and replaced at no cost to Owner.
- C. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Examine the areas and conditions under which excavating and filling is to be performed and notify Owner in writing of conditions detrimental to proper and timely completion of work.
- C. Correct unsatisfactory conditions in a manner acceptable to owner prior to proceeding with work.
- D. Maintain in operation condition existing utilities, active utilities and drainage systems encountered in utility installation. Repair any surface or subsurface improvements as shown on Drawings.
- E. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- F. Verify structural ability of unsupported walls to support imposed loads by the fill.
- G. Notify utility company to remove and relocate utilities.

3.02 INSPECTION

- A. Verify stockpiled fill to be reused is approved.
- B. Verify areas to be backfilled are free of organics, debris, snow, ice or water, and surfaces are not frozen.

3.03 PREPARATION

- A. When necessary, compact subgrade surfaces to density requirements for aggregate base and aggregate subbase materials.
- B. Identify known underground utilities. Stake and flag locations.
- C. Identify and flag surface and aerial utilities.
- D. Notify utility companies of work to be done.
- E. Locate, identify, and protect utilities that remain and protect from damage.
- F. Proofroll subgrade surface to identify soft spots.
- G. Cut out soft areas of subgrade not capable of compaction in place. Backfill with select fill above the groundwater table or crushed stone below the groundwater table.

3.04 FOUNDATION PREPARATION

- A. Topsoil and pavement shall be removed from proposed building area.
- B. Overexcavate the pile cap and grade beam subgrades by 12 inches and replace with 12 inches of compacted crushed stone to provide a stable working mat and drainage media for dewatering.
- C. Excavation to subgrade shall be made with a smooth-edge bucket to lessen disturbance of subgrade soils.
- D. Soil fill placed adjacent to foundations exposed to freezing temperatures and as backfill around features such as bollards and light pole bases shall be structural fill.
- E. Soil fill placed adjacent to foundation not exposed to freezing temperatures shall be granular borrow.
- F. Place all fill in horizontal lifts and compact such that the desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. Loose lift thickness for soil fills shall not exceed 12 inches.
- G. Sub-slab fill shall be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557

- H. Exterior foundation backfill shall be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557 beneath paved areas, entrance slabs and adjacent to sidewalk areas. All other areas shall be compacted to at least 90 percent of its maximum of its maximum dry density as determined by ASTM D-1557.
- I. Backfill for foundation walls acting as retaining walls shall be compacted to between 90 and 95 percent of ASTM D-1557 to avoid additional lateral stress on the walls associated with over-excavation.
- J. Crushed stone shall be compacted to 100 percent of its dry rodded unit weight as determined by ASTM C-29
- K. An exterior perimeter foundation drainage system using rigid 4" diameter SDR-35 pipe shall be provided with 6 inches of crushed stone wrapped in non-woven geotextile fabric. Set the foundation drain adjacent to the footing, above the 12 inch working mat.
- L. Exterior foundation backfill shall be sealed with a surficial layer of clayey or loamy soil in areas that are not paved or occupied by entrance slabs.

3.05 EXCAVATING

- A. Underpin adjacent structures which may be damaged by excavating work.
- B. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Excavate materials encountered when establishing required subgrade elevations in accordance with Maine DOT Specification Sections 203.04 and 203.05.
- D. Remove lumped subsoil, boulders, solid mortared stone masonry, concrete masonry and rock up to 2 cubic yards, measured by volume.
- E. Conform to elevations, contours, dimensions, line and grade shown on the drawings.
- F. When excavating through roots is necessary , perform work by hand and cut roots with a sharp axe.
- G. Slope banks of excavations deeper then 4 feet to angle of repose or flatter until shored. All excavations shall be consistent with OSHA regulations.
- H. Do not excavate wet subsoil
- I. Remove all existing fill soils from beneath foundations.
- J. Do not interfere with 45 degree bearing splay of foundations
- K. Correct areas that are over-excavated and load-bearing surfaces that are disturbed at no cost to Owner
- L. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- M. Remove excavated material that is unsuitable for re-use form site.
- N. Surplus Material:
 - 1. Make arrangements to provide suitable disposal areas off-site
 - 2. Deposit and grade material to the satisfaction of the owner of the property on which the material is deposited.
 - 3. Obtain any necessary permits for disposal.
 - 4. Provide suitable watertight vehicles to haul soft or wet materials over streets or pavements to prevent deposits on same.
 - 5. Keep crosswalks, streets, and pavements clean and free of debris.
 - 6. Clean up materials dropped from vehicles as often as directed by Owner.
- O. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd (0.25 cu m) measured by volume.

3.06 FILLING AND SUBGRADE PREPARATION

- A. Topsoil and pavement shall be removed from proposed fill and pavement areas.
- B. Proofroll exterior pavement subgrades using a 10-ton vibratory roller-compactor, unless otherwise noted. Any areas that continue to yield after 3 to 5 passes of the compaction equipment shall be over-excavated and replaced with clean granular borrow in dry, non-freezing conditions, and select fill in other conditions.
- C. Pavement subgrade in fill areas shall consist of Granular Borrow compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557.
- D. Landscape subgrade shall consist of Common Borrow compacted to at least 90 percent of its maximum dry density as determined by ASTM D-1557
- E. Place and compact fill materials in continuous layers not exceeding 12 inches loose depth upon compacted material.
- F. Employ a placement method that does not disturb or damage other work.
- G. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- H. Maintain optimum moisture content of fill materials to attain required compaction density.
- I. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- J. Correct areas that are over-excavated:
 - 1. Load-bearing foundation surfaces: Fill with concrete.
 - 2. Pavement areas: Use granular borrow above the groundwater table in the event of dry, non-freezing conditions or select fill in other conditions and crushed stone below the groundwater table, flush to required elevation, compacted to 95 percent of maximum dry density.
 - 3. Other areas: Use Granular Borrow, flush to required subgrade elevations, compacted to minimum 95 percent of maximum dry density. Use select fill or crushed stone as necessary to backfill wet areas of over excavation.
- K. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
 - 2. At other locations: 90 percent of maximum dry density.
- L. Leave stockpile areas completely free of excess fill materials
- M. Reshape and re-compact fills subjected to vehicular traffic.
- N. Frost:
 - 1. Do not excavate to full indicated depth when freezing temperatures may be expected unless fill material or structures can be constructed immediately after the excavation has been completed. Protect the excavation from frost if placing of fill or structure is delayed.
 - 2. Fill shall not be placed over frozen soil. Soil that is frozen shall be removed prior to placement of compacted fill. Remove all frozen uncompacted soil prior to placing additional fill for compaction.

- O. Native soils can undergo substantial strength loss when subjected to construction traffic and excavation activities, particularly during periods of precipitation and shallow groundwater levels. Care must be exercised to minimize disturbance of the bearing soils. Should the subgrade become yielding or difficult to work, disturbed areas shall be excavated and backfilled in accordance with Section 3.06 L.
- P. Clean granular soil meeting the structural fill gradation shall be provided to a depth of 4.5 feet below the top of entrance slabs and sidewalks in contact with the structure. The thickness of structural fill shall extend horizontally from the structure outward to a point at least one foot beyond the adjacent subbase at a 1V to 3H slope or flatter

3.07 CONSTRUCTION OF AGGREGATE BASE AND SUBBASE COURSE

- A. Place and compact aggregate base and subbase course materials in continuous layers not exceeding 12 inches loose depth upon compacted material, unless noted otherwise.
- B. Employ a placement method so not to disturb or damage structures and utilities.
- C. Spread well-mixed materials having no pockets of either fine or coarse materials.
- D. Do not segregate large or fine particles.
- E. Compacted by mechanical means to obtain 95 percent of maximum dry density as determined in accordance with ASTM D 1557. Base course material shall be compacted with a minimum of two passes with self propelled vibratory compaction equipment.
- F. Maintain surface, compaction and stability until placement course has been placed.
- G. Conform to elevations, contours, dimensions, line and grade shown on the Drawings.

3.08 DUST CONTROL

- A. Upon request of Owner, implement the following dust control measures:
 - 1. Apply water and calcium chloride as directed by Owner.
 - 2. Spread calcium chloride uniformly over designated area.
 - 3. Apply water with equipment having a tank with pressure pump and nozzle equipped spray bar acceptable to Owner.

3.09 TOLERANCES

- A. Top surface of base and subbase course: Plus or minus 3/8 inch.

3.10 FIELD QUALITY CONTROL

- A. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.
- B. Compaction density testing will be performed by the Owner of compacted fill in accordance with ASTM D 2922.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor") or ASTM D 1557 ("modified Proctor") as appropriate for soil type.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.
- E. Frequency of Tests:
 - 1. Building subgrade areas, including 10'-0" outside exterior building lines: In fill areas, not less than one compaction test on each lift for every 2,500 square feet. Proofroll cut areas.
 - 2. Areas of construction exclusive of building subgrade: In fill areas, not less than one compaction test on each lift for every 10,000 square feet. Proof roll cut areas.

3.11 PROTECTION

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect newly graded areas from traffic and erosion and keep free of trash and debris.
- D. Repair and re-establish grades in settled, eroded and rutted areas within specified tolerances.
- E. Slope fill surfaces to shed water.

3.12 ATTACHMENTS

- A. "Explorations and Geotechnical Services, Proposed Office Building and Parking Garage, Preble Street and Marginal Way, Portland, Maine" prepared by S.W. Cole Engineering, Inc. of Gray, Maine and dated May 17, 2006.
- B. "Supplemental Geotechnical Services, Proposed Office Building and Parking Garage, Preble Street and Marginal Way, Portland, Maine" prepared by S.W. Cole Engineering, Inc. of Gray Maine and dated February 16, 2007.

END OF SECTION 02315