

**SECTION 31 20 00
EARTH MOVING**

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

- A. Commonwealth of Pennsylvania Department of Transportation Specifications, Publication 408/2020.

1.3 SUMMARY

- A. Section Includes:
 - 1. Preparing subgrades for walks and pavements.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Subbase course for concrete walks and pavements.
 - 4. Subbase course for asphalt paving.
 - 5. Excavating and backfilling trenches for utilities and drainage structures.
 - 6. Placing Topsoil

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.
 - 3. Structure Backfill: Backfill comprised of satisfactory soils with physical characteristics allowing for performance of a Standard Proctor or Modified Proctor on the material.
 - 4. Engineered Backfill: Backfill comprised of durable well-graded mixture of natural or crushed gravel, crushed stone, and/or natural or crushed sand.
- B. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated. All excavation shall be considered to be unclassified.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Geotechnical Engineer. Authorized

additional excavation and replacement material will be paid for in accordance with Contract provisions for changes in work.

2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Geotechnical Engineer. Unauthorized excavation, as well as remedial work directed by Geotechnical Engineer, shall be without additional compensation.

- E. Fill: Soil materials used to raise existing grades.
- F. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.
- G. 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.
- H. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- J. Topsoil: Upper, outermost layer of soil having a high concentration of organic matter with a soil structure that promotes water retention and is reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 ACTION SUBMITTALS

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

1.6 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 as follows:
 1. Classification according to ASTM D 2487.
 2. Laboratory compaction curve according to ASTM D 1557.
- C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.7 BASIS OF CONTRACT

- A. Excavation for this Project shall be considered unclassified and shall include all types of earth and soil, any pebbles, boulders, and bedrock, municipal trash, rubbish and garbage and all types of debris of the construction industry such as wood, stone, concrete, plaster, brick, mortar, steel and iron shapes, pipe, wire, asphaltic materials, paper and glass. Unclassified excavation does not include unforeseen concrete foundations, walls, or slabs. All such materials encountered which are identified by this paragraph as unclassified shall be removed to the required widths and depths to create a finished product as shown and/or noted on the drawings and as written in the specifications. No additional compensation shall be made to the contractor for this unclassified excavation. The materials defined by this paragraph as unclassified will not be considered to be concealed conditions or unknown physical conditions below the surface of the ground for purposes of interpreting the language in the General Conditions to the Construction Contract.

1.8 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.9 SUBSURFACE INFORMATION

- A. No subsurface information is available for this project.

1.10 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Client Agency and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Client Agency or authorities having jurisdiction.
- B. Utility Locator Service: Notify Pennsylvania One Call Service for area where Project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GC, GM, SW, SC, and SM according to ASTM D 2487 or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Liquid Limit: Less than or equal to 40
 2. Plasticity Index: Less than or equal to 25
 3. Total expansion determined in accordance with PennDOT PTM 130: Less than 0.50%.
 4. Soil fill or aggregate containing more than 0.1% total sulfur by weight as determined by ASTM D4239 should be evaluated by Wet-Dry Durability testing in accordance with PennDOT PTM 519 in order to determine the potential for expansion by sulfide to sulfate conversion, and to determine if they can be classified as satisfactory.
- C. Unsatisfactory Soils: Soil Classification Groups GP, SP, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percentage points of optimum moisture content at time of compaction.
 2. Soil material containing pyrite, expansive materials, marcasite, carbonaceous materials, topsoil, wood, peat, and containing other substances which can be dissolved or leached and undergo expansive reactions in the presence of moisture will be classified as unsatisfactory soils.
 3. Material, which by virtue of its particle size or shape cannot be properly and effectively compacted, will be classified as unsatisfactory soils.
 4. Blast Furnace Slag, Steel Slag, and Granulated Slag will be classified as unsatisfactory soils.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inchsieve and not more than 12 percent passing a No. 200sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inchsieve and not more than 8 percent passing a No. 200sieve.
- F. Structure Backfill: Naturally occurring or manipulated satisfactory soil with characteristics that permit proctor testing of the material.
- G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inchsieve and not more than 12 percent passing a No. 200sieve.
- H. 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-inchsieve and not more than 8 percent passing a No. 200sieve.
- I. Drainage Course: Narrowly 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 0 to 5 percent passing a No. 8sieve.
- J. 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.
- K. Sand: ASTM C 33; fine aggregate.

- L. Topsoil: Material comprised mineral particles and organic matter.
1. On-site source shall be a friable loam that is reasonably free of subsoil, clay lumps, brush, roots, weeds, other objectionable vegetation, stones, other foreign material larger than 2 inches in any dimension, litter, and/or material objectionable or harmful to plant growth.
 2. Off-site (Imported) source shall meet the above requirements and contain not less than 2% nor more than 10% organic matter, according to AASHTO T 194. Material shall have 100% passing the 2-inch sieve, 75% passing the No. 4 sieve, and 60% passing the No. 10 sieve. Sand, Silt, and Clay material passing the No. 10 sieve shall be within the following limits: Sand - 5% minimum to 70% maximum; Silt - 10% minimum to 70% maximum; and Clay - 5% minimum to 36% maximum.
- M. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
1. Impervious Fill shall consist of cohesive materials having at least 50% passing the U.S. Standard 200 mesh sieve size.
 2. Cohesive materials shall consist of materials classifying as lean (CL) or fat clay (CH), having a Plasticity Index of 10 or greater and fall between the "U" line and the "A" line on Figure 4 in ASTM D 2487 – Standard Practices for Classifications of Soils for Engineering Purposes.

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. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 3. Permittivity: 0.1 per second, minimum; ASTM D 4491.
 4. 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. Apparent Opening Size: No. 30 sieve, maximum; ASTM D 4751.
 3. Permittivity: 0.60 per second, minimum; ASTM D 4491.
 4. UV Stability: 80 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, 3/8-inch nominal maximum aggregate size.
 4. Water: ASTM C 94/C 94M.
 5. Air-Entraining Admixture: ASTM C 260.

- B. Produce conventional-weight, controlled low-strength material with 125-psi compressive strength when tested according to ASTM C 495.

2.4 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.

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 and in no case shall the site be left open and unsealed at the end of the day.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and replace with satisfactory soil materials.
 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
- B. Subgrade preparation operations shall consist of the stripping of any vegetation, rootmat, topsoil, asphalt, and any other soft or unsuitable material from the proposed building and pavement areas. The stripping limits should be extended at least ten (10) feet beyond the planned limits of the proposed building and paved areas, where possible. Stripping limits should be extended an additional one (1) foot for each foot of fill required at the building or pavements exterior edges. Unless otherwise noted, subgrade preparation shall also include removal of all remnants of existing structures, including all foundations, floor slabs, underground utilities, septic tanks, drains, and any other below-grade structures from below the proposed building pad. Existing foundations in any planned landscaped or parking areas may remain in place provide they are cut off at least two (2) feet below the final subgrade and any hollow cores are grouted solid.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
1. 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. Undercut the existing soil below building footing elevation a minimum of 2 feet and proof-roll with earthmoving and compaction equipment (such as a 10-ton weight smooth drum vibratory roller) until no perceptible movement is observed. Use a walk-behind roller where a large roller cannot be accommodated in the footing excavation.
- C. Backfill the undercut below the building footings with AASHTO No. 57 stone or PennDOT No. 2A coarse aggregate. The lateral extent of the backfill should extend a minimum distance of 1/2 the depth of undercut beyond the planned edge of footings. Place all fill in maximum 9-inch loose lifts and compact each lift with a minimum 10-ton vibratory roller until visual non-movement is achieved with a minimum of 4 passes with the roller. In areas that prevent access for a 10-ton roller, a smaller walk behind roller or vibrating tamper can be used; however, the lift thickness shall be reduced to a maximum of 5 inches.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit, unless otherwise indicated.
- C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 APPROVAL OF BEARING STRATA

- A. The Contractor shall furnish adequate advance notification to the Department and the Professional of times when footing excavations or paving subgrades are to be completed, so that the Construction Stage Geotech Quality Assurance Agent can verify that the bearing quality of the soil has been properly inspected and/or tested by the Contractor. Formwork and concreting shall follow only after approval by the Construction Stage Geotech Quality Assurance Agent.
- B. Should the bearing at the levels indicated be found by the Professional and the Department to be inadequate, they may order the excavation carried down to sound bearing. Such excavation shall be classed as additional work and payment be made on the basis of an agreed price according to the General Conditions. Should suitable bearing be found at a lesser depth than indicated, the Professional and the Department may order the reduction of excavation specified or shown on the drawings, and the Contractor shall allow a credit for excavation thus omitted on the same basis.

3.9 SUBGRADE PROOF-ROLLING AND DAMAGED SUBGRADE REPAIR

- A. Proof-roll subgrade with an approved piece of equipment, such as a fully loaded tri-axle dump truck with a minimum loaded weight of 30 tons in the area of the proposed building and 20 tons in the area of proposed concrete pavement and full depth asphalt pavement. Proof-roll isolated areas with a heavy walk-behind type roller with a minimum static weight of 1,500 pounds.
 - 1. Soft or loose zones delineated by proof-rolling that are not able to be stabilized shall be undercut to a depth of 2'-0" or to competent material (whichever occurs first), or to a depth below proposed subgrade as directed by the Construction Stage Geotech Quality

- Assurance Agent, and replaced with inert granular material or coarse aggregate or lean concrete. In the event severe cases of subgrade deflection/rutting is encountered, the Construction Stage Geotech Quality Assurance Agent will direct the Contactor to place a geogrid between the soft soil and the fill material.
2. Limits of over excavation shall extend horizontally beyond the planned footing/foundation limit a minimum of 6 inches for every foot of vertical depth below planned subgrade/bearing elevation.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Construction Stage Geotech Quality Assurance Agent, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2000 psi, may be used.
1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Geotechnical Engineer.

3.11 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
 2. Excavated satisfactory soils may require drying prior to use as a result of the elevated in-situ moisture content. Drying operation shall be accomplished by spreading the material in thin layers, disking and turning over until adequately dry for compaction.

3.12 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Construction below finish grade including.
 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.
- B. Place and compact backfill in layers to required elevations as follows:
1. Under walks and pavements, use structure backfill or engineered backfill.
 2. Under steps and ramps, use structure backfill or engineered backfill.
 3. Under slabs on grade, use engineered backfill.
 4. Under footings and foundations, use engineered backfill.
- C. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete".
- D. Trenches under Roadways: 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 Section 033000 "Cast-in-Place Concrete".
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch 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. Coordinate backfilling with utilities testing.
- H. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- J. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.14 FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Place soil fill on subgrades free of mud, frost, snow or ice.
- C. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- D. Place and compact fill material in layers to required elevations as follows:
 - 1. Under future grass and planted areas, use satisfactory soil material.

3.15 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percentage points of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percentage points and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 4 inches in loose depth for material compacted by hand-operated tampers and not more than 9 inches in loose depth for material compacted by heavy compaction equipment (a sheepsfoot, or segmented pad roller should be used for fine-grained cohesive soils and a smooth drum roller for coarse-grained cohesionless soil).
- B. Place fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact fine-grained or cohesive fill soil materials, including impervious fill, within 3% of its optimum moisture content to not less than 95 percent of optimum dry density as estimated by ASTM D 1557, Modified Proctor Method.
- D. Compact clean, coarse-grained, cohesionless fill soil materials to at least 70% of its relative density as estimated by ASTM D 4253 and D 4254.
- E. When material is too coarse to perform a proctor (more than 20% retained on the 3/4-inch sieve and less than 35% passing the No. 200 sieve, or more than 30% retained on the 3/4-inch sieve), compaction will be determined in accordance with PennDOT Publication 408 based on non-movement of the material under compaction equipment or under a loaded dump truck, having an axle weight of at least 10 tons. Placement of this material is limited to vehicular roadways and parking areas.

3.17 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 the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
 - 3. Pavements: Plus or minus 1/2 inch.

- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Shape subbase course to required crown elevations and cross-slope grades.
 - 3. Place subbase course 6 inches or less in compacted thickness in a single layer.
 - 4. Place subbase 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.
 - 5. Compact granular fill/backfill to a minimum of 70 percent relative density as defined by ASTM D 4253 and ASTM D 4254.
- C. Pavement Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase layer.

3.19 SUBSURFACE DRAINAGE

- A. Subsurface Drain (Foundation Drain): Place subsurface drainage geotextile/filter fabric around perimeter of perforated drainage pipe. Encase/embed sub-drainage pipe in washed gravel such as AASHTO #57 stone.
 - 1. Compact granular fill/backfill to a minimum of 70 percent relative density as defined by ASTM D 4253 and ASTM D 4254.
- B. Drainage Backfill (Walls): Place and compact granular fill material from the wall face to a minimum of 2'-0" behind the wall. Granular fill shall be #57 stone, run-of-bank gravel, 2RC gravel, or any free draining material. Satisfactory soil shall be placed and compacted beyond the 2'-0" lateral distance behind the wall.
 - 1. Compact granular fill/backfill to a minimum of 70 percent relative density as defined by ASTM D 4253 and ASTM D 4254.

3.20 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. 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 granular fill/backfill to a minimum of 70 percent relative density as defined by ASTM D 4253 and ASTM D 4254.

3.21 TOPSOIL PLACEMENT

- A. Place topsoil in accordance with PennDOT Publication 408, Section 802.3.

3.22 QUALITY CONTROL TESTING

- A. The Contractor shall perform all necessary Quality Control tests and procedures for the performance of the work, in accordance with Section 014000 and this section, to produce the end results specified. The Contractor's Quality Control Agent shall maintain clear and orderly records of such tests and procedures and make them available for field review and approval of the Professional and the Department. The Contractor's bid shall include the cost of all Quality Control tests and inspections.
- B. The Contractor shall submit its plan for Quality Control testing to the Professional and the Department for review and comments. The Professional shall consult with its Quality Assurance Agent in arriving at its opinion.
- C. Quality Control tests shall include tests on fill material, optimum moisture content and maximum density and field density tests of fill layers. The Quality Control Agent shall comment on the suitability of all subgrades, and the subgrades shall be acceptable to the Consulting Geotechnical Engineer.
- D. Handwritten copies of field test reports shall be provided to the Contractor. They shall be given to the Contractor and inspector within two (2) hours of completion, but in no event shall the technician leave the site without providing the Contractor and inspector with a copy of the test results. This shall include density, % moisture, plan location, elevation, comments and any other relevant data. Comments shall include any condition that might have an adverse effect on the operations, including weather, drainage, etc.
- E. The Contractor shall request consultation with the Consulting Geotechnical Engineer on any problems that arise during construction. Copies of the daily in-place soil density tests shall be faxed to the consultant by the Contractor through the testing agency within twenty-four (24) hours of the time the tests are made.
- F. The Contractor shall approve each subgrade and each fill layer before proceeding to the next layer. Any area which does not meet density, % moisture or other requirements at any time, shall be suitably reworked and retested by the Contractor at his own expense.
- G. The Professional and/or the Department will perform all Quality Assurance Testing and Inspection Services deemed necessary for the assurance of the Professional and/or the Department. This does not relieve the Contractor of his responsibilities. The Department will bear the cost of Quality Assurance tests and inspections.
- H. 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.
- I. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 5000 sq. ft. or less of paved area or building slab, but in no case fewer than two tests.
2. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
3. Foundation and Retaining Wall Backfill: At each compacted backfill layer, at least one test for every 50 feet or less of wall length, but no fewer than two tests.
4. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 50 feet or less of trench length, but no fewer than two tests.

3.23 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. At the end of each work day, Contractor shall "seal" the surface of the final lift of fill placed that day with a smooth-drum roller compactor to mitigate infiltration of potential precipitation into the fill.
- C. Repair and reestablish grades to the specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 1. Scarify or remove and replace soil material to depth as directed by Architect, reshape and recompact.
- D. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.24 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Client Agency's property.

END OF SECTION