

SECTION 2
DIVISION 31
EARTH MOVING – APPENDIX

DIVISION 31 – EARTH MOVING APPENDIX

SECTION 31 2000 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses and exterior plants.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Drainage course for slabs-on-grade.
 - 4. Subbase course for concrete walks and pavements.
 - 5. Subbase and base course for asphalt paving.
- B. Related Sections include the following:
 - 1. Division 1 Section "Allowances" for quantity allowance provisions related to unit-price rock excavation and authorized additional excavation.
 - 2. Division 1 Section "Unit Prices" for unit-price rock excavation and authorized additional excavation provisions.
 - 3. Division 1 Section "01040 – Control of Blasting Operations" for additional blasting requirements.
 - 4. Division 2 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping topsoil, and removal of above- and below-grade improvements and utilities.
 - 5. Division 2 Section "Sub-drainage" for drainage of foundations, slabs-on-grade, walls and landscaped areas.
 - 6. Divisions 2, 15, and 16 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.

1.3 UNIT PRICES

- A. Unit prices for earthwork are included in Division 1 Section "Unit Prices."
- B. The following prices shown include measurement by cross section, contractor shall employ a land surveyor, registered in the State of North Carolina, acceptable to the Designer and University, to measure and seal all cross section calculations.
 - 1. General mass site rock disposed of offsite. Measurement shall be by cross section prior to excavation. Unit prices shall include time, labor, transportation, all offsite disposal costs, and measurement.
 - 2. Also included is replacement of qualified rock volume with equal volume of imported structural fill, which will include purchase, transportation, placement and compaction.
 - 3. Utility trench rock or pit rock used or disposed of off site. Measurement shall be by cross section of excavation. Unit price shall include removal, transportation, offsite disposal, and measurement. Also included is replacement of qualified rock volume with equal

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volume of imported structural fill, which will include purchase, transportation, placement and compaction.

4. Removal and offsite disposal of unsuitable soil. Measure shall be by cross section of excavation. Unit price shall include removal, transportation, all offsite disposal costs, and measurement. Also included is replacement of qualified rock volume with equal volume of imported structural fill, which will include purchase, transportation, placement and compaction.
 5. Import structural soil: Measurement shall be by cross section of excavation. Unit price shall include purchase, transportation, placement, compaction and measurement.
- C. Basis of Measurement: The quantity of undercut and rock excavation shall be the number of cubic yards of rock or unsuitable material, authorized by the Geotech Engineer to be removed, measured in its original position by a land surveyor, registered in the State of North Carolina. Surveyor shall calculate actual rock quantities.
- D. Basis of Payment: Payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for all materials, equipment, labor, tools and incidentals necessary to complete the item regardless of the depth encountered, only the material authorized by Geotech Engineer and Architect shall be paid for. The price includes disposal of unsuitable material off of job site. Material used to replace rock or "undercut" areas shall be obtained from approved off site borrow source or suitable on site material. Also, see 5 sketches at the end of this section describe conditions for rock payment.

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: Course placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices and 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 Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Difficult Excavation/Weathered Rock: Material that has a density of between 100 and 200 blows per foot. This material can be excavated by a D-9 Dozer with a single or double shank ripper though production will be slow. Difficult excavation/weathered rock can be anticipated and shall be accomplished within the base bid. No unit price will be established and no additional cost will be allowed.
- I. Mass rock excavation consists of the removal and satisfactory disposal off site per applicable unit price of bedrock, rock in lenses, or boulders 1 cubic yard or larger composed of hard

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granite or similar material requiring the use of rock drills and specialized equipment for removal, and that is measured, in place, prior to removal. In the event rock as defined above is encountered, the contractor shall immediately notify the Geotech Engineer and the Architect. If requested, the contractor shall demonstrate that material cannot be removed by ripping with a D-9 dozer or equal equipped with a single tooth ripper or a crawler tractor rated at a penetration force of 34,000 pounds, with a pry out force of 72,000 pounds, pulling a single-tooth ripper, with ripping performed in a crisscross pattern or against the natural bedding plane. The Contractor may be required to provide equipment specification data verifying the above minimum-rated equipment will be used for demonstration purposes. The equipment is to be in good repair and in proper working condition.

1. If rock is encountered, the contract sum shall be adjusted in accordance with the unit prices submitted by the contractor after the attached Rock Excavation Approval Form is completed.
2. Upon encountering rock, the contractor shall remove all overburden from the material and notify the Geotech Engineer and Architect that the material is ready for measurement. The Geotech Engineer will then determine if the material is qualified rock, 48 hours, excluding weekends and holidays, after receipt of contractor's notice. Once the material is judged as qualified rock, the contractor's registered land surveyor shall survey, by cross section, the rock in place and submit the cross sections and calculations to the architect and geotechnical engineer for approval. All parties must agree, and confirm quantities, evidenced by their signature on the "rock excavation approval form," prior to removal of rock.
3. Any material moved or removed without the measurement and approval will be considered as earth excavation. The Geotech Engineer, with concurrence from the Architect, shall be the final judge on what is to be classified as rock excavation.
4. Limit of payment shall be from top of rock to 6 inches below subgrade, as indicated on rock removal conditions 1-5 attached.

J. Trench rock excavation consists of the removal and satisfactory disposal off site of material composed of hard granite or similar material in trenches less than 10 feet wide that **cannot** be effectively removed using a 125-hp excavator with a pull of 36,500 pounds at the rate of 6 inches per 10 minutes or more or a backhoe equipped with a minimum ½ cubic yard heavy-duty trenching bucket placed on a machine capable of a lifting capacity of 7,500 pounds at a trench depth of 10 feet at the rate of 6 inches per 10 minutes or more, and that is measured, in place, prior to removal. In the event rock as defined above is encountered, the contractor shall immediately notify the soils engineer. The Contractor may be required to provide equipment specification data verifying that the above minimum-rated equipment will be used for demonstration purposes. The equipment is to be in good repair and in proper working conditions.

1. If trench rock is encountered, the contract sum shall be adjusted in accordance with the unit prices submitted by the contractor after the attached Rock Excavation Approval Form is completed.
2. Any material moved or removed without the measurement and approval will be considered as earth excavation. The Geotech Engineer, with concurrence from the Architect, shall be the final judge on what is to be classified as rock excavation.
3. Upon encountering rock, the contractor shall remove all overburden from the material and notify the Geotech Engineer and Architect that the material is ready for measurement. The Geotech Engineer will then determine if the material is qualified rock, 48 hours, excluding weekends and holidays, after receipt of contractor's notice. Once the material is judged as qualified rock, the contractor's registered land surveyor shall survey, by cross section, the rock in place and submit the cross sections and calculations to the architect and geotechnical engineer for approval. All parties must agree, and confirm quantities, evidenced by their signature on the "rock excavation approval form," prior to removal of rock.

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4. The trench rock payment limit shall generally be the diameter of the pipe plus 2 feet, by the depth of the pipe plus 6 inches, as indicated on attached rock removal conditions 1-5.
 5. For rock excavation, a trench shall be defined as a linear excavation that is 5 feet or less in width and 2 feet or greater in depth. All other rock excavation shall be considered general mass rock excavation.
 6. Trenches that are located within the limits of mass rock removal shall be classified as mass rock.
- K. 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.
- L. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- M. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- N. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- 1.5 SUBMITTALS
- A. Product Data: For the following:
1. Each type of plastic warning tape.
 2. Geotextile.
- B. Samples: 12-by-12-inch samples of subdrainage geotextile.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
 2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.
- 1.6 QUALITY ASSURANCE
- 1.7 Pre-excavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Quality Requirements."
- A. Dirt, Concrete, asphalt and rock removed as a result of earthmoving projects are not to be sent to a landfill and should either be reused on site or should be sent to a reclamation facility for screening and re-use.
- 1.8 PROJECT CONDITIONS
- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
1. Notify Architect not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Architect's written permission.
 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

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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: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, 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.
- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, AND PT or combination of these group symbols. Suitable of soils shall be determined by onsite Geotechnical Engineer. Unsuitable soil shall be so classified by structure, content, unit weight less than 90 lbs., plastic soils, etc. Soils too wet or too dry will not be considered unsuitable if useable at optimum moisture. Unsuitable soil is only defined below subgrade elevations.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of 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. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- K. Backfill and Fill: Satisfactory soil materials.

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. 40 No. 60 No. 70 sieve, maximum; ASTM D 4751.
 - 7. Permittivity: 0.5 per second, minimum; ASTM D 4491.

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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 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
- B. 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 earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 2 Section "Site Clearing," during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

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

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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.
2. Install a dewatering system specified in Division 2 Section “Dewatering” to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

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. Do not damage adjacent structures, property, or site improvements or weaken the bearing capacity of rock subgrade when using explosives.
 2. Use of explosives shall be permitted only after submittal of an approved blasting plan and only as required to remove rock.
 3. Coordinate with university construction manager for owner approval and notices to the campus community.

3.4 EXCAVATION, GENERAL

- A. 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 by the Geotech Engineer, cross sectioned by the registered Land Surveyor, and reviewed by the Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in 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 is earth excavation.
 2. Rock excavation includes removal and disposal of rock.
 - a. Do not excavate rock until it has been classified by the Geotech Engineer, cross sectioned by the Surveyor, and reviewed by the Architect..

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.
- B. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.6 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.

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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.
 - 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. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 2. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
 - D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- 3.8 SUBGRADE INSPECTION
- A. Notify Architect when excavations have reached required subgrade.
 - B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - C. Proof-roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
 - D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
 - E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.
- 3.9 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 2500 psi, may be used when approved by Architect.
 1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.
- 3.10 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.

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1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, sub-drainage, 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.

3.12 UTILITY TRENCH BACKFILL

- A. 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.
- B. 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.
- C. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- D. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- E. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 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 satisfactory soil material.
 2. Under walks and pavements, use satisfactory soil material.
 3. Under steps and ramps, use engineered fill.
 4. Under building slabs, use engineered fill.
 5. Under footings and foundations, use engineered fill.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 % 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% and is too wet to compact to specified dry unit weight.

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3.15 **COMPACTION OF SOIL BACKFILLS AND FILLS**

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent. Additionally, under all site pavements and floor slabs, upper 18" of subgrade to be compacted to 100%. Under heavy duty asphalt pavements, upper 24" of subgrade to be compacted to 100%.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at [95] percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.

3.16 **GRADING**

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn 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.

3.17 **SUBSURFACE DRAINAGE**

- A. Sub-drainage Pipe: Specified in Division 2 Section "Sub-drainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of sub-drainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support sub-drainage pipe. Encase sub-drainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 95% of maximum dry unit weight according to ASTM D 698.
 - 2. Place and compact impervious fill over drainage backfill in 6 inch thick compacted layers to final subgrade.

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3.18 SUBBASE AND BASE COURSES

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 - 1. Place base course material over subbase course under hot-mix asphalt pavement.
 - 2. Shape subbase and base course to required crown elevations and cross-slope grades.
 - 3. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
 - 4. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 5. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698, ASTM D 1557.
- C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.19 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Place drainage course 6 inches or less in compacted thickness in a single layer.
 - 2. 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.
 - 3. 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.

3.20 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. 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.
- D. 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 1 test for every 4000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

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- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.21 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 Architect; reshape and re-compact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

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