
SECTION 31 05 10

SOILS AND AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
1. Engineered soils and aggregates materials
 2. Bank run soils materials
 3. Manufactured and special soils

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
1. ASTM C33 Spec. for Concrete Aggregates.
 2. ASTM C88 Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 3. ASTM C117 Test for Material Finer than No. 200 Sieve in Mineral Aggregates by Washing.
 4. ASTM C131 Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 5. ASTM C136 Sieve Analysis of Fine and Coarse Aggregates.
 6. ASTM C144 Spec. for Aggregate for Masonry Mortar.
 7. ASTM C207 Spec. for Hydrated Lime for Masonry Purposes.
 8. ASTM C535 Test for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 9. ASTM C602 Spec. for Agricultural Liming Materials.
 10. ASTM D75 Sampling Aggregates.
 11. ASTM D422 Particle Size Analysis of Soils.
 12. ASTM D448 Spec. for Standard Sizes of Coarse Aggregate for Highway Construction.
 13. ASTM D1140 Test for Amount of Material in Soils Finer than the No. 200 Sieve.
 14. ASTM D1241 Spec. for Materials for Soil-Aggregate Subbase, Base, and Surface Courses.
 15. ASTM D2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
 16. ASTM D2487 Classification of Soils for Engineering Purposes.
 17. ASTM D4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity of Soils.
 18. ASTM D5268 Standard Specification for Topsoil Used for Landscaping Purposes.

1.3 SUBMITTALS

- A. Provide test reports showing the results of required material testing.
- B. Provide topsoil analysis performed in accordance with ASTM D5268 and demonstrating the topsoil meets Soil Conservation Service specified soil types. Also, submit results of test for nutrient levels and provide recommendations for fertilizer type and application.
- C. Daily delivery tickets for each load of material delivered to the site.

1.4 QUALITY ASSURANCE

- A. An independent testing laboratory approved by the Owner shall be obtained by the Contractor and provide quality control testing.

PART 2 - PRODUCTS

2.1 ENGINEERED SOILS AND AGGREGATES (SOIL CLASS A)

- A. General
 - 1. Material shall be clean, sound, hard, dense, durable, field or quarry stone which is free from seams, cracks, or other structural defects. It shall be angular material from shot rock (blasted) or crushed rock having substantially all face of which have resulted from artificial crushing.

2.2 ENGINEERED SOILS AND AGGREGATES (SOIL CLASS B)

- A. General
 - 1. Aggregate shall be hard, strong, durable particles free from seams, cracks, and other structural defects.
 - 2. Rounded to subangular.
 - 3. Free from organic impurities and debris.
 - 4. Material shall not be frozen.

B. Gradation

- 1. Soil Class B-2 (Coarse Aggregate - ASTM C33 - No. 7)

Sieve Size	% Passing by Weight
¾-inch	100
½-inch	90-100
3/8-inch	40-70
No. 4	0-15
No. 8	0-5

2.3 ENGINEERED SOILS AND AGGREGATES (Soil Class C)

A. General

1. Stone shall be hard, durable, granular material of uniform quality resulting from crushed rock or crushed bank run sand and gravel.
2. Material shall be free from clay lump, organic matter, shale, excess, elongated or flat pieces, and other deleterious substances.

2.4 BANK RUN SOILS

A. Soil Class F-1 (Topsoil)

1. Topsoil shall meet the definition and specification stated in ASTM D5268 and meets one of the following SCS (Soil Conservation Service) soil textures:
 - a. Loam.
 - b. Sandy loam.
 - c. Silt loam.
 - d. Silty clay loam.
 - e. Clay loam.
2. The topsoil shall consist of adequate mineral content to support the growth of the intended vegetation and shall not contain herbicides which would be detrimental for the intended use.
3. The topsoil shall have adequate fertility for quick establishment of vegetation.
4. The pH of the topsoil shall be between 6.0 and 7.0.
5. Topsoil shall be free from deleterious substances.
6. Pulverize and screen the topsoil such that 100 percent passes the 1-inch (25 mm) sieve and at least 90 percent passes the No. 10 (2.00 mm).

B. Soil Class G-1 (Clean Earth Fill)

1. Soil Class G-1 shall be any soil material excavated on the project site or obtained from borrow areas.
2. Soil materials unsuitable and, therefore, not approved for this classification are:
 - a. Soils with high organic contents such as: topsoil, peat, muck, organic silts, and clays, marls, etc.
 - b. Manmade or rubble filled soils containing such materials as: foundry sand, fly ash cinders, asphalt, and concrete rubble, etc.
 - c. Silty soils such as: rock flour, loess, etc.
 - d. Soils with gravel larger than 3-inch.
 - e. Silty clay or clays with a high plasticity (CH soils as defined in ASTM D2487).
 - f. All soil contaminated with hazardous waste materials as defined by the EPA.

2.5 SOURCE QUALITY CONTROL

- A. To establish acceptability of material, perform tests for each soils class in accordance to the following standards:
1. One (1) test per 500 cy of material placed.
 2. Perform one (1) acceptable test for each type of material at each source.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Use the soil classification as specified or stated on Drawings.
- B. Place material in accordance with the Drawings and appropriate Specification Sections for the type of work being performed.

END OF SECTION

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EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Excavation.
 - 2. Test rolling.
 - 3. Filling and compacting.
 - 4. Backfilling around structures.
 - 5. Disposal of surplus materials.
 - 6. Finish grading.

- B. Allowances
 - 1. Testing costs shall be included in the cost for earthwork.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. D1556 Test for Density of Soil in Place by the Sand-Cone Method
 - 2. D1557 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Lb (4.54 kg) Rammer and 18 in. (457 mm) Drop
 - 3. D2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
 - 4. D2922 Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 - 5. D3017 Test for Moisture Content of Soil and Soil-Aggregate by Nuclear Method (Shallow Depth)

1.3 SUBMITTALS

- A. Submit two (2) copies of the results of quality control testing (include location where test was done):

1.4 QUALITY CONTROL

- A. An independent testing laboratory approved by the Owner shall be obtained by the Contractor and provide quality control testing.

- B. Material Testing Requirements
 - 1. Source Testing of Aggregate:

- a. Test all select soils and aggregates for acceptance as required by Section "Soils and Aggregates".
- 2. Installation Testing:
 - a. Determine maximum density and optimum moisture content for compaction in accordance with ASTM D1557 (one test for each type of material for each source).
 - b. Conduct field density tests in accordance with ASTM D1556 and/or D2922 and D3017.
 - c. Minimum frequency for field density testing shall be two (2) acceptable tests per project or as follows, whichever number is greater:

Fill Utilized For	Number of Acceptable Tests
Embankments, dikes or berms	1 test per 600 cubic yards
Structural or controlled fills	1 test per 200 cubic yards
Trench backfill under paved or surfaced areas	1 test per 100 feet of trench
Non-structural fills	1 test per 2,000 cubic yards

- 3. Provide Additional Density and Gradation Testing:
 - a. Change in method of compaction.
 - b. Change in source or quality of soil or aggregate.
 - c. Disturbed cut areas.
- C. When the testing results show that the work is of an acceptable nature, the acceptance of the work shall not relieve the Contractor from making corrections to the tested work during the warranty period.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Soil used for borrow, fill, and backfilling shall meet the requirements of soil class as stated in the drawings or in the Specifications.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavation to Correct Grade
 - 1. Excavate site for structures and pavements as follows:
 - a. To elevation shown on the plans.
 - b. To such additional width as necessary for erections and removal of forms, shoring or sheeting, and finishing of walls.
 - 2. Excavation of unsuitable materials.
 - a. Excavate unsuitable soil materials under a proposed structure.
 - b. Extend excavation laterally a minimum of 5 feet beyond the building limits plus 1 foot for each foot of cut below the foundation.

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- c. Notify the Owner's project representative prior to proceeding with the removal of unsuitable material.

B. Borrow Excavation

- 1. Clear site as defined in Section "Site Clearing."
- 2. Strip and stockpile topsoil.
- 3. Excavate, haul, place, and compact borrow soil material.
- 4. Regrade borrow areas as shown on the plans or in an acceptable manner to facilitate proper site drainage.
- 5. Replace stockpiled topsoil.
- 6. Surplus topsoil may be utilized in borrow area regrading.
- 7. Seed and mulch in accordance with Section "Landscaping - Turf Establishment".

C. Excavation Precautions

- 1. Excavation Slope Stability:
 - a. Maintain excavation slope to ensure a stable excavation and prevent caving.
 - b. Provide and erect all timber work, shoring, sheeting, bracing, etc. necessary to prevent caving and displacement of adjacent property.
 - 1) Shoring shall be placed so as not to interfere with building work.
 - 2) Shoring shall be independent of footings.

3.2 TEST ROLLING

- A. Test roll finished cut or fill subgrades by rolling with a pneumatic-tire roller or a heavy weight loader rubber tire vehicle.
 - 1. Method and equipment used shall be suitable for intended use.
 - 2. Take necessary precautions to protect existing structures from damage during test rolling.
 - 3. Test roll an area equal to the area of the proposed construction plus a minimum of 3 feet on each side.
- B. Treat areas showing yielding or rutting under test rolling as follows:
 - 1. Replace and/or recompact as necessary to stabilize the area.
 - 2. Retest soil areas replaced or recompact.

3.3 FILLING AND COMPACTING

- A. Layer thickness for fill soil shall be as follows:
 - 1. Layer thickness shall be dependent on the soil classification type, weight, and soil contact pressure of compaction equipment being used.
 - 2. Layer thickness shall not exceed 8 inches.
- B. Compaction
 - 1. Compaction method for fill soils shall be appropriate for soil material being compacted and provide sufficient soil contact pressure to thoroughly compact entire lift thickness.

- C. Compaction requirements for all fill soils unless specified elsewhere shall be as follows:

- | | |
|---------|--|
| Class 1 | - Fills supporting structures.
- Subgrade under pavements or floors.
- Backfill under piping and conduits. |
| Class 2 | - Fills which do not support structures.
- Embankments, dikes, or berms. |

COMPACTATION REQUIREMENTS FOR
VARIOUS SOIL CLASSES

Required Compaction (%) of Modified
Proctor Density

Class 1	Class 2
95	90

- D. Soil classes not requiring compaction by the above schedule will be proof rolled when requested by the Engineer.

3.4 DISPOSAL OF SURPLUS MATERIALS

- A. Haul and dispose of all surplus materials.
- B. Provide disposal area for surplus materials.

3.5 FINISH GRADING

- A. Grade, trim, and shape subgrade to required grade and section.
1. Adjust slopes by grading so that transition is smooth and gradual.
 2. The crests of cut banks shall be rounded and shaped.
 3. Refill, regrade and compact washouts and ruts.
 4. Remove all stones 1.5 inches or larger from beneath the dewatering pad liner.
- B. Vertical Grading Tolerances
1. Rough grading tolerance.
 - a. Areas to be topsoiled - rough grade to within 0.2 foot of finish grades.
 2. Areas having paved surfaces (i.e., concrete, asphalt, etc.).
 - a. Maximum allowable variation from correct profile and section shall not be more than ¼ inch in 10 feet.

END OF SECTION

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GEOTEXTILE FABRICS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
1. Geotextile fabrics for geotextile dewatering tubes
 2. Geotextile fabrics for dewatering pad geomembrane protection
 3. Geotextile fabrics for erosion control

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
1. ASTM D4355 Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water.
 2. ASTM D4533 Test Method for Trapezoid Tearing Strength of Geotextiles.
 3. ASTM D4491 Test Methods for Water Permeability of Geotextiles by Permittivity.
 4. ASTM D4595 Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 5. ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles.
 6. ASTM D4751 Test Method for Determining the Apparent Opening Size of a Geotextile.
 7. ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
 8. ASTM D4884 Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles.
 9. ASTM D5261 Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

1.3 SUBMITTALS

- A. Provide, at the time of delivery of the geotextile fabric, a manufacturer's Certificate of Compliance that the geotextile fabric meets the requirements of this Section.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver geotextile fabric in a wrapping which will protect the fabric from ultraviolet radiation and from abrasion due to shipping and hauling.
- B. Store geotextile fabric in a dry location until installed.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide geotextile fabric consisting of either woven or non-woven polyester, polypropylene, stabilized nylon, polyethylene or polyvinylidene chloride. All fabric shall have the minimum strength values in the weakest principle direction. Non-woven fabric may be needle punched, heat bonded, resin bonded or combinations thereof.
- B. The geotextile fabric shall be insect, rodent, mildew and rot resistant.
- C. Clearly mark the geotextile fabric rolls showing the type of fabric.
- D. Where sewn seams are used, provide a field sewn seam sample produced from the geotextile fabric and thread and with the equipment to be used on the project, prior to its incorporation into the work.

2.2 MATERIALS

A. Non-Woven Geotextile Fabric

- 1. Non-woven geotextile fabric shall be used beneath the dewatering pad drainage stone.
- 2. The fabric shall comply with the following physical properties:

Test	Method	Value ¹
Grab Tensile Strength (lbs.)	ASTM D4632	160 min.
Puncture Strength (lbs.)	ASTM D4833	85 min.
Apparent Breaking Elongation (%)	ASTM D4632	50 min.
Apparent Opening Size (U.S. Standard Sieve)	ASTM D4751	70
Permittivity, sec. ⁻¹	ASTM D4491	1.30 min.

¹All numerical values represent minimum/maximum average roll values (i.e., the average of minimum test results on any roll in a lot should meet or exceed the minimum specified values).

- 3. The following fabrics are approved:
 - a. Propex Geotex 601
 - b. GSE NW6
 - c. Mirafi-160N
 - d. Approved equal.
- B. Woven Geotextile Fabric for Geotextile Dewatering Tubes
 - 1. Geotextile dewatering tube material shall be fabricated from polypropylene multifilament and monofilament yarns, which are woven into a stable network such that the yarns retain their relative position. The geotextile dewatering tube material shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids.

2. The geotextile dewatering tube material shall be fabricated by sewing together mill widths of geotextile to form a tubular shape.
3. Geotextile dewatering tubes fabricated 45 feet or greater in circumference must be fabricated with the mill roll length of the geotextile and the adjacent seams being in the circumferential direction with the closure of the tube having a longitudinal seam on the bottom of the container. Each tube shall be fabricated with one or more PVC filling ports located along the top centerline. The filling port is comprised of 1.5 inch thick inside and outside flange rings that sandwich the geotextile surface between 1/8-inch thick rubber gaskets secured with 3/4-inch bolts. Additionally, the fill port shall include a fabric sleeve that clamps around the feed line to prevent leakage.
4. PVC fill ports for the attachment of the dredge to the tube shall be located at intervals of no more than 100 feet, or as recommended by the manufacturer. Fill ports shall be ridged PVC with an inner port body and outer port body each comprising one or more cellular surfaces capable of distributing a force caused by the clamping of the inner port body and outer port body together with steel bolts and nuts. Fill ports shall be either 4-inch or 8-inch in diameter with a 48-inch long, flexible non-woven 8 oz/sy geotextile sleeve.
5. The fabric shall comply with the following minimum physical requirements:

Parameter	Method	Value ¹	
		MD	XD
Wide Width Tensile Strength (ppi at ultimate)	ASTM D4595	400	550
Wide Width Tensile Elongation (percent)	ASTM D4595	20 max	
Apparent Opening Size (U.S. sieve size)	ASTM D4751	40	
UV Degradation (% strength retained after 500 hr)	ASTM D4355	80	
Water Flow Rate (gpm/sq ft)	ASTM D4491	20	
Mass/Unit Area (oz/sq yd)	ASTM D5261	17.3 (typical value)	
Factory Seam Strength (ppi)	ASTM D4884	400	

¹All numerical values represent minimum/maximum average roll values (i.e., the average of test results on any roll in a lot should meet or exceed the minimum values in the table.

6. The fabric shall be insect, rodent, mildew and rot resistant.
7. The following woven fabrics are approved:
 - a. Ten Cate Nicolon – GT 500
 - b. Approved Equal
8. Geotextile dewatering tubes shall be 60-foot circumference by 120 feet long.
9. Contractor shall provide dewatering tube geotextile with a factor of safety of at least 3 for failure of seams and material failure.

PART 3 - EXECUTION

3.1 SEWING

- A. Sew factory and field seams with a thread having the same or greater durability as the material in the fabric. The seams shall be parallel stitch lines with 1.4 inch spacing. The sewing thread shall be multi-ply polyester filament yarn.
- B. Seams shall develop a tensile strength equal to or greater than 80 percent of the specified grab tensile strength of the fabric, unless otherwise specified.

- END OF SECTION -