

SECTION 02201

STRUCTURAL SOIL

PART 1 - GENERAL

1.01 SUMMARY

- A. Work described in this section includes requirements for mixing and placement of structural soil matrix for tree planting in areas where surrounding subsoil's have been compacted and are inadequate for proper tree root development.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. ASTM D422 - Standard Method for Particle Size Analysis of Soils.
 2. ASTM D1140 - Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75 um) Sieve.
 3. ASTM D1556 - Standard Test Method for Density of Soil in-Place by the Sand Cone Method.
 4. ASTM D698 - Standard Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 5.5-lb (2.49 kg) Rammer and 12-inch (305 mm) Drop.
 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in-Place by the Rubber Balloon Method.
 6. ASTM D2487 - Standard Test Method for Classification of Soils for Engineering Purposes.
 7. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in-Place by Nuclear Methods (Shallow-Depth).
 8. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in-Place by Nuclear Methods (Shallow Depth).

1.03 DEFINITIONS

- A. Standard Specification: "Minnesota Department of Transportation Standard Specifications for Construction; 2000 Edition".
- B. Structural Soil: Matrix consisting of coarse gravel, filler soil, hydrophilic polymer (for material not mixed in place) and fertilizer.
- C. Influence Zone Around Piping or Electrical Ducts: Area below limits bounded by line 12 inches above pipe or duct and by 1 horizontal to 2 vertical slopes extending outward from the line 1 foot beyond outer edge of pipe or duct.

- D. Influence Zone Under Roadways or Berms: Area below roadway or berm sub base bounded by 1 horizontal to 2 vertical slopes extending outward from 1 foot beyond outer edges of roadway or berm.
- E. Unsuitable Material: Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble or soil with less than required bearing capacity as determined by ENGINEER.
- F. Utilities: Existing gas mains; water mains; electric lines; conduits, telephone, and other communication lines; sewer pipe; other utilities, and appurtenances.

1.04 QUALITY ASSURANCE

- A. Field quality control testing shall be performed by CONTRACTOR in accordance with Section 01410 and this section.
- B. Sol Material Source Quality Control
 - 1. Independent soils laboratory shall be approved by OWNER.
 - 2. Source testing to be performed by CONTRACTOR at no cost to the OWNER.
 - 3. Provide the following test results for granular drainage layer material test requirements:

Property	Test Method	Frequency
Grain Size Analysis	ASTM D422/D1120	3 test results/source
Standard Proctor	ASTM D698	3 test results/source
USCS soil classification	ASTM D2487	3 test results/source

- B. Pre-Cast Concrete Structure Source Quality Control:
 - 1. Precast Reinforced Concrete Manhole Testing:
 - a. Test risers and tops in accordance with ASTM C497 for compressive strength compliance by compression tests on cores -drilled from 5% of lot.
 - b. May reduce number of compression tests to 1% of lot, with minimum 2 cores per lot, for manhole sections fabricated on sewer pipe machine.
 - c. OWNER will approve testing laboratory.
 - d. Manufacturer's core drilling machine shall conform to ASTM C497. Operator will take test cores as directed by testing laboratory.
 - e. Stamp risers and tops, meeting strength requirements, with appropriate monogram.

C. Geotextile Source Quality Control

- 1. Roll Identification:

- a. Provide geotextiles in rolls wrapped in relatively impermeable and opaque protective covers and marked or tagged with following information:
 - i. Manufacturer's name
 - ii. Product identification
 - iii. Lot number
 - iv. Roll number
 - v. Roll dimensions
- b. Indicate special handling marked on geotextile itself, e.g., "This Side Up".
- c. Conformance testing to indicated conformance with specifications.

2. Handle geotextiles in such manner as to insure geotextiles are not damaged.

1.05 SUBMITTALS

- A. Shoring, Bracing, and Sheet Piling Construction Procedures and Details:
ENGINEER will not review shoring, bracing, and sheet piling construction procedures and details for structural integrity or effect on existing facilities.
- B. Location of off-site source of materials.
- C. Name, address, telephone number and contact person of independent soils laboratory.
- D. Method of off-site source soils material sampling and analyses.
- E. Off-site source material analyses.
- F. Source testing results shall be provided at least 30 days prior to installation.
- G. Proposed haul road plan for transportation of all off-site materials to the Project site.
- H. Submit method of placement and mixing
- I. Submit in accordance with Section 01300.

1.06 PROJECT/SITE CONDITIONS

- A. Sheeting, Bracing, and Shoring:
 - 1. When close sheeting is required, drive to prevent soil from entering trench below or through such sheeting.
 - 2. Fill voids remaining after sheeting pulled with sand or other approved material

1.07 FIELD MEASUREMENTS

- A. Verify control monuments and intended elevations for Work as shown on Drawings.

1.08 COORDINATION

- A. Coordinate work with others performing work at project site
- B. Call utilities prior to beginning Work.

PART 2 - PRODUCTS

2.01 STRUCTURAL SOIL

- A. Mixture consisting of coarse gravel, loam filler soil and hydrophilic polymer such that the mixture is approx. 80% coarse gravel, approx. 20% loam filler soil and 0.03% hydrophilic polymer.
- B. Hydrophilic polymer not required for material “mixed” in place

2.02 COARSE GRAVEL

- A. Coarse gravel shall be riprap meeting the requirements of Standard Specification 3601.A1.
- B. Gradation shall meet requirements Standard Specification Section 3601.A.2.d for revet mattresses; 3” (75 mm) to 6” (150 mm)

2.03 LOAM FILLER SOIL

- A. Loamy soil meeting requirements of Standard Specification Section 2572.2.D – Sandy Loam Topsoil

2.04 HYDROPHILLIC POLYMER

- A. Hydrophilic polymer shall conform to requirements of Standard Specification Section 2571.2.C.1.j.

2.05 CASTINGS

- A. Conform to requirements of ASTM A48, Class 30-B and dimensions shown on Drawings.
- B. Castings shall be free from cracks, holes, swells, and cold shunts.
- C. Aeration Inlets shall be Neenah Casting R-2569 or approved equivalent.
- D. Tree Grates shall be 6’ x 6’ Neenah Tree Grate or approved equivalent.

2.06 CONCRETE TREE PLANTER BOX

- A. Concrete Tree Planter Box shall be pre-cast concrete box

- B. Planter Box shall be constructed in accordance with ASTM C478.
- C. Dimensions of planter box
 - a. 5' W x 5' L by 30" deep
 - b. Wall thickness to be 6" minimum
 - c. There shall be two openings to allow root development on each side of the tree box that are at least 1.5 square feet per opening. Openings to be trapezoidal, rectangular or "doghouse" shaped.

2.07 GEOTEXTILE

- A. Geotextile underlayment shall meet requirements of Standard Specification Section 3733, Type II.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine and verify acceptability and condition of surfaces to perform Work.
- B. Examine surfaces to receive fill to determine existence of areas loosened by frost action, softened by flooding or weather or of unsuitable materials.
- C. In the event that the CONTRACTOR believes the existing conditions survey or the quantities obtained from such survey to be inaccurate, the CONTRACTOR shall immediately notify the OWNER and provide documentation in a timely fashion and at such a point in the project that the OWNER may independently verify the findings of the CONTRACTOR. Should the contractor begin earthwork activities without such notice to the OWNER, it will be expressly understood that no claims based on a survey discrepancy will be considered by the OWNER.

3.02 PREPARATION

- A. Identify required lines, grades, levels, contours, and datum.
- B. Protect benchmarks, structures, equipment, and partially completed Work.
- C. Install erosion protection measures as required prior to initiating earthwork.
- D. Over excavate soft areas of subgrade not capable of in-situ compaction as directed by ENGINEER.
- E. Notify corporations, companies, individuals, or authorities owning above- or belowground conduits, wires, pipes, or other utilities running to property or encountered during excavating operations.

- F. Protect, support, and maintain conduits, wires, pipes, and other remaining utilities in accordance with requirements of owners of said services.
- G. CONTRACTOR may encounter groundwater and upward seepage during construction and is responsible for the following:
 - 1. Keep construction site free-draining.
 - 2. Keep excavations free from water.
 - 3. Maintain groundwater minimum of 12 inches below excavations and sump locations.
 - 4. Remove soil disturbed by pressure or flow of groundwater.
 - 5. Replace 12 inches removed material with free-draining aggregate capable of alleviating uplift pressure, as directed by OWNER.
 - 6. Wrap free-draining aggregate in 8-ounce geotextile (See Section 02271).
 - 7. Maintain dewatering system during construction to prevent uplifting of structures or materials.
 - 8. Protect adjacent properties from damage resulting from dewatering operations.
 - 9. Dewatering wells shall be drilled, maintained, and abandoned in accordance with federal, state, and local ordinances.
 - 10. Keep surface water from flowing into existing leachate collection system.
 - 11. Keep surface water from ponding near or flowing into subsoils below existing composite liner system
 - 12. Dewatering is incidental and shall be performed in accordance with Section 02222 – Dewatering.
- H. Keep construction site free-draining.
- I. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation work.
- J. Remove all topsoil, organic material, and soft, wet, or loose soils below proposed berm and roadway areas. During excavation or exposure of in-situ soils, the CONTRACTOR shall subcut beneath plan subgrade if soft, wet, or loose soils are encountered. Replace unsuitable materials with controlled fill material. Soft, wet, loose, and competent soils will be determined by the ENGINEER.
- K. The CONTRACTOR shall stage construction to prevent slippage or sloughing of the berms during construction.

3.03 EXCAVATION - GENERAL

- A. Excavations shall conform to lines and grades as staked, and as shown on Drawings.
- B. Excavations beyond those lines and grades without the ENGINEER'S authorization will be considered unauthorized work.
- C. Excavation shall be performed, at a minimum, to the lines and grades indicated on the Drawings. Additional excavation shall be performed to achieve a stable working base or to “bridge” over weak subgrade materials at no additional cost to OWNER. The limits of excavation shall be determined by the OWNER.

- D. Do not excavate within influence zone of existing footings or foundations without prior approval of ENGINEER.

3.04 ON-SITE MIXING OF STRUCTURAL SOIL

- A. Mix structural soil in batches of an appropriate size for the equipment being used. No more material shall be mixed than can be placed the same day. Material mixed but not placed that same day will be discarded and removed from site.
- B. Mix materials to be uniform blend in the following manner
 - a. Begin with approximately one half of the coarse gravel, all of the loam filler soil and the hydrophilic polymer.
 - b. Add approximately 1 gallon of water/cubic yard of structural soil to be mixed
 - c. Blend into a uniform mixture
 - d. Add remaining coarse gravel and another ½ gallon of water per cubic yard of structural soil to be mixed
 - e. Blend into a uniform mixture
 - f. Mixture is well blended and at the appropriate moisture content when the loam soil fill coats coarse gravel without falling out of the matrix and doesn't clump up or run out with excess water.
- C. Mixed structural soil to be placed as described in Section 3.05 below.

3.05 COARSE GRAVEL PLACEMENT

- A. Notify ENGINEER before placing fill material.
- B. Do not use frozen material or place fill on frozen subgrade.
- C. Where pipes or electrical conduits leave structures, protect by backfilling pipe or duct influence zone down to undisturbed soil with controlled fill.
- D. Place fill simultaneously on both sides of free-standing structures.
- E. Place material in 15" to 18" loose lifts and compact using vibratory plate compactor or self-propelled vibratory roller compactor with static weight of no more than 12 tons. Complete between 2 and 4 passes. Additional passes may be required when using a vibratory plate compactor. Material shall be compacted until no further consolidation is observed by ENGINEER.
- F. Place concrete tree planting box in specified locations after first lift of coarse gravel is placed. Use concrete paver blocks to level tree box and achieve proper finish grade of tree box as necessary.

3.06 LOAM SOIL INFILL PLACEMENT

- A. Notify ENGINEER before placing fill material.

- B. Do not use frozen material or place fill on frozen subgrade.
- C. Place approximately 1” of loam soil infill material on top of previously placed and compacted coarse gravel. Wash soil into voids of coarse gravel using clean potable water. Soil infill is considered sufficiently blended in when surface of coarse gravel appears to be uniformly coated with soil infill.
- D. Spread slow release fertilizer at manufacturers recommended rate.
- E. Repeat process outlined in Sections 3.05 and 3.06 until specified structural soil thickness is achieved. Thickness of structural soil shall be 36” unless otherwise identified on the Drawings.

3.07 GEOTEXTILE INSTALLATION

- A. Place geotextile above completed structural soil matrix as shown on DRAWINGS.
- B. General.
 - a. Roll out in a manner to keep material in constant tension.
 - b. Weight material with sandbags or approved equivalent during installation to prevent movement and wind disruption. Keep weight in-place until cover material is applied.
 - c. Prevent damage to underlying material during installation.
 - d. During installation, do not entrap stones, soil, dust, or moisture which would damage underlying material, hamper seaming, or impede performance of the product.
 - e. Do not expose material to precipitation prior to installation.
 - f. Do not expose material to direct sunlight for more than 300 hours prior to installation.
- C. Seams.
 - a. Seam by sewing, fusion, or other approved methods.
 - b. Seam shall be continuous.
 - c. Overlap shall be a minimum of 6 inches.
 - d. Thread shall be polymeric with properties equal to or exceeding the geotextile.
- D. Install geotextile around protruding appurtenances as shown on the Drawings.
- E. Repair
 - a. Non-slope areas - spot seam fabric patch in-place with a minimum 24-inch overlap in each direction.
 - b. Remove debris, soil, or other material which may have penetrated geotextile.
- F. Installation Around Appurtenances:
 - a. Install geotextile around appurtenances protruding through geotextile as shown on Drawings.
 - b. After material is placed and seamed, complete final field seam connection between appurtenance sleeve or shield or geotextile. Maintain sufficient initial overlap of appurtenance sleeve so shifts in location of geotextile can be accommodated.

3.08 TREE PLANTING

- A. Plant trees and fill concrete tree boxes with planting soil in accordance with Standard Specification Section 2571.

3.09 SETTING FRAMES AND CASTINGS

- A. Set at elevation shown on Drawings.
- B. Install aeration inlets above geotextile
- C. Install tree grates after tree planting is complete and set on concrete tree box.

3.10 FIELD QUALITY CONTROL

- A. Precast reinforced tree planting boxes shall be subject to rejection for failure to conform to Specification requirements. In addition, tree boxes may be rejected because of any of following reasons.
 - 1. Fractures or cracks passing through shell, except for single end crack not exceeding depth of joint.
 - 2. Defects indicating imperfect proportioning, mixing, and molding.
 - 3. Surface defects indicating honeycombed or open texture.
 - 4. Damaged ends where such damage prevents making satisfactory joint.
 - 5. Internal thickness of section varying more than 1% from nominal thickness.
 - 6. Any continuous crack having surface width of 0.01 in. or more-and extending for length of 12 in. or more, regardless of position.

3.11 PUMPING AND DRAINAGE

- A. At all times during construction, the CONTRACTOR shall provide, maintain and operate proper equipment and facilities to remove all water entering excavations and keep such excavations dry and free of silt, so as to obtain a satisfactory subgrade to allow the construction of the re-compacted soil. CONTRACTOR will be responsible for all costs associated with maintaining a dry excavation.
- B. Following each rainfall event, the CONTRACTOR will immediately inspect the excavation area. Should any standing water be observed, the Contractor will begin pumping or take action to remove the standing water.
- C. Drainage shall be disposed of only in an area approved by the OWNER and Technical Representative.

3.12 TRANSPORTATION AND HAUL ROADS

- A. Observe State, County, and Local traffic rules and weight restrictions.
- B. All vehicle trips loaded or unloaded shall be on designated haul roads only.

- C. CONTRACTOR to coordinate selection of haul roads with the appropriate governing body and acquire any necessary permits.

3.13 ADJUSTMENT AND CLEANING

- A. The CONTRACTOR shall remove surplus materials and debris from the site.
- B. The CONTRACTOR shall satisfactorily dispose of all excess excavated material that cannot be used, unless arrangements are made with the OWNER.

END OF SECTION