# PART C – MATERIALS
# SAMPLING/TESTING/INSPECTION REQUIREMENTS

## DIVISION C200 – EARTHWORK

### SECTION C200 – EARTHWORK

**C200.01 Summary.** Soils provide the primary foundation for all highway construction. Soil may be required to support a roadway, an embankment, a multi-span bridge, or other infrastructure components. Due to the importance of these components, knowledge of soil conditions at the site during design and construction is of utmost importance.

Soils investigations are generally performed during two stages of development in a highway project and, when necessary, during the construction stage. Soils investigations are required during:

(a) **Preliminary planning** to help determine the optimum alignment based upon existing soil conditions. It is important that planners have, at a minimum, general knowledge of soil conditions so that they are aware of potential problems that may occur prior to the choice of an alignment. Other considerations that should be taken into account when choosing an alignment include; land value, ecology, historical landmarks, and existing highway alignment.

(b) **Preliminary design** to provide characteristics relevant to the classification and engineering properties of the soil to the designer. At the preliminary design stage of a project, an in-depth soil investigation should be initiated to determine soil classification and engineering properties. The extent of the investigation depends on the size and type of the project. The soil investigation includes the identification of soil characteristics that might influence the design and construction of the project such as soil type, strength, compaction, and depth.

Soils investigations may also be required during construction to provide more information about unexpected conditions in the field that may be encountered during construction. Occasionally, problems occur during construction that were not visible during the preliminary design investigation. The extent of this investigation depends upon the specific problem encountered.

**C200.02 Production and Operations.** Requests for soil investigations generally originate from one of the following sections of DelDOT:

(a) Planning

(b) Construction Districts

(c) Regional Group Engineers

(d) Bridge Design Engineer

The requests should be accompanied by plans that indicate the type of construction to occur or reason for the soil investigation (to determine the extent of the investigation) and the location of the investigation. Design Guide memorandums 1-9 and 1-10 outline the information necessary to request a soil investigation.

Before any fieldwork is started, the location of existing utilities must be determined and marked. This is done not only to prevent damage to the utilities or testing personnel, but also to ensure that areas disturbed by the utility construction are not sampled or tested, which would lead to a misrepresentation of the existing site soil conditions.

Once the area has been reviewed, work is performed in accordance with the following procedures and with due consideration for safety and maintenance of traffic.

**C200.03 Obtaining Samples.** There are numerous procedures for obtaining in-situ soil samples. The procedures that are followed are dependent upon the extent of the soil investigation, which is determined at the project level. Test Method Numbers and DOH numbers applicable to soil sampling are listed in Table C-1.

With the approval of the Engineer, these procedures may be further modified as conditions dictate.

**C200.04 Handling, Packaging, and Shipping.** Soil samples that are obtained in the field are carefully handled to ensure that the material is as undisturbed from site conditions as feasibly possible. Soil samples obtained during a subsurface investigation are put in airtight bags to preserve the moisture and fine material contents. Shelby tube samples are carefully handled to ensure that the material is undisturbed and representative of the in-situ condition. Soil samples are delivered to the central lab and are assigned an identification number that links the sample and test information to the contract, job site, date the sample was obtained, and other pertinent information. The Identification system for soil samples at the Materials & Research Laboratory is shown in Table C-2.

**C200.05 Tests Performed.** Upon receiving the sample, the Materials and Research Laboratory initiates the test procedures pertinent to the project from which the sample was obtained. Test procedures that may be performed on a specific soil sample are listed in Table C-3. Test information for soils is recorded on specific forms for consistency. Auger boring test results are recorded on Form LB-41, while deep borings are recorded on Form LB-43. Borrow pit sample information is documented on Form LB-42. Field control sampling is recorded on Form LB-44. Moisture-Density tests are documented on Form LB-48. Form LB-45 is used to record the specific gravity of soils. Copies of these forms are provided in Part E.

In addition to obtaining and testing soil samples, the Materials & Research Laboratory may also certify or test other items that are included in the Division 200 Items list, such as geotextiles and Portland cement concrete items. Certified materials, such as geotextiles, are verified for their physical properties according to the standards and test methods that are listed in Table C-3. Portland cement concrete items are tested according to procedures specified in Table C-2.

**C200.06 Test Report Evaluations and Distributions.** The following shows how data is handled for each Section requesting information:

(a) *Planning.* Field and laboratory results are accompanied by a report or letter, which contains a discussion of the results and general recommendations for construction. One copy of the results and report or letter is sent to the Planning office.

(b) *Construction Districts.* Usually, field and laboratory results and construction recommendations are provided. The variability in requests from Construction units results in each response being tailored to the specific request. One copy of results and report or letter is sent to the District Construction Engineer and to the designer of record.

(c) *Regional Group Engineer.* Field and laboratory results are accompanied by a report or letter, which contains a discussion of the results and specific recommendations for construction including a detailed evaluation of settlement and stability if necessary. Pavement thickness designs are performed by the Pavement Design Engineer and are included when requested. One copy of the results, report or letter, and pavement design is sent to the Regional Group Engineer.

(d) *Bridge Design.* For structures, only field and laboratory results are provided. When bridge approaches cross problem soil areas, specific embankment construction recommendations based on settlement and stability analyses are provided in a report or letter discussing the results of the soil investigation. One copy of results and report or letter is sent to the Bridge Design Engineer.

(e) *Review.* Only field and laboratory results are provided. Two copies of the results are sent to the Review Engineer.

Soils information provided for any other section is handled as the situation dictates.

| Table C-1: Division 200 - Sampling Methods | |
|---|---|
| **Method ID** | **Method Name** |
| DOH 3 | Sampling Soil and Aggregate Base |
| DOH 4 | Borrow Pit Sampling for Source Approval |
| DOH 18 | Soil Investigation & Sampling with a 25 mm Retractable Plug Sampler |
| AASHTO T86 | Investigations and Sampling Soils and Rock for Engineering Purposes |
| AASHTO T206 | Penetration Test & Split-Barrel Sampling of Soils |
| AASHTO T207 | Thin-Walled Tube Sampling of Soils |
| AASHTO T225 | Diamond Core Drilling for Site Investigation |

| Table C-2: Division 200 - Sample Identification Numbering |
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| Soil Samples are numbered consecutively each year beginning with Test # 1 on the first day of the new fiscal year, July 1, and ending on June 30 |

| Table C-3: Division 200 - Test Methods | |
|---|---|
| **Test ID** | **Test Name** |
| DOH 2 | Method of Determination of Moisture Content |
| DOH 7 | Source Control - Borrow |
| DOH 9 | pH of Soil and Topsoil |
| DOH 19 | Recommended Practice for Description of Soils (Visual - Manual Procedure) |
| AASHTO T11 | Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing |
| AASHTO T19 | Bulk Density (" Unit Weight") and Voids in Aggregate |
| AASHTO T21 | Organic Impurities in Fine Aggregates for Concrete |
| AASHTO T27 | Sieve Analysis of Fine and Coarse Aggregates |
| AASHTO T85 | Specific Gravity and Absorption of Coarse Aggregate |
| AASHTO T87 | Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test |
| AASHTO T88 | Particle Size Analysis of Soils |
| AASHTO T89 | Determining the Liquid Limit of Soils |
| AASHTO T90 | Determining the Plastic Limit and Plasticity Index of Soils |
| AASHTO T96 | Resistance to degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| AASHTO T99 | Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in) Drop |
| AASHTO T100 | Specific Gravity of Soils |
| AASHTO T134 | Moisture-Density Relations of Soil-Cement Mixtures |
| AASHTO T180 | Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in) Drop |
| AASHTO T208 | Unconfined Compressive Strength of Cohesive Soil |
| AASHTO T216 | One-Dimensional Consolidation Properties of Soils |
| AASHTO T265 | Laboratory Determination of Moisture Content of Soils |
| AASHTO T267 | Determination of Organic Content in Soils by Loss on Ignition |
| AASHTO T310 | In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) |

| Table C-4: Division 200 - Certification Test Procedures / Material Standards | |
|---|---|
| **Test ID** | **Test Name** |
| VADOT VTM 51 | Filtering Efficiency and Flow Rate of a Filter Fabric |
| ASTM A478 | Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire |
| ASTM D3776 | Standard Test Methods for Mass Per Unit Area (Weight) of Fabric |
| ASTM D3786 | Standard Test Method for Hydraulic Bursting Strength of Textile Fabric-Diaphragm Bursting Strength Tester Method |
| ASTM D4101 | Standard Specification of Polypropylene Injection and Extrusion Materials |
| ASTM D4355 | Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus) |
| ASTM D4491 | Standard Test Methods for Water Permeability of Geotextiles by Permittivity |
| ASTM D4533 | Standard Test Method for Trapezoid Tearing Strength of Geotextiles |
| ASTM D4632 | Standard Test Method for Grab Breaking Load and Elongation of Geotextiles |
| AASHTO M31 | Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |