

Part 533 – Geotechnical Engineering

Subpart C – Operations

533.20 General

A. Soil mechanics is a branch of soil physics and engineering mechanics that describes the behavior of soils and provides the theoretical basis for analysis in geotechnical engineering. Soil mechanics is the application of the laws and principles of mechanics and hydraulics to engineering problems dealing with soil as an engineering material. The testing of soil's properties are typically done at a testing laboratory with specialized equipment or can be measured or correlated in the field. Soil mechanics is a subdivision of civil engineering and engineering geology that evaluates the action of forces within a soil mass for natural or artificial structures that are supported on or made of soil.

B. Collection and analysis of geotechnical engineering data are essential in the investigation and design of engineering structures. The examination and verification of soil properties during construction are critical. Specialized training and experience in geotechnical engineering are needed due to the many factors which depend on interpretation and judgment of soil related issues. Close coordination is needed between the investigation, soil testing, design, and construction functions.

C. Soil mechanics testing provides data for evaluating soil and rock as engineering materials for planning, design, and construction. Test results identify the index, chemical, and engineering properties used in the analysis and design of foundations and earth or earth-supported structures such as dams, buildings, bridge foundations, retaining walls, as well as the support structure of buried pipeline systems.

533.21 Data Collection

A. The engineering staff or team that prepares the final design will assist in planning of the geotechnical site investigation, sample selection, and final soil testing program.

B. All data needed for analyzing soil conditions pertinent to planning, designing, and constructing engineering structures must be obtained for each phase. Field tests and interpretation procedures in Part 531, Subpart A, "Geologic Investigations," of this manual must be used to determine as many in-situ soil properties as practical. If further testing is needed or verification of field conditions is in order, appropriate representative samples must be obtained for laboratory testing.

C. Before completion of the geologic investigation, the geologist, the engineer designated for geotechnical engineering leadership, the project engineer, or some combination of these individuals must jointly review the results of the investigation and the adequacy of sampling for testing. The data must be examined to determine that it is adequate for use in all stages of design and construction.

533.22 Testing

A. Soil mechanics testing must conform to established NRCS and American Society for Testing and Materials (ASTM) standards and procedures. The testing must be completed at appropriate times during the investigation, design, and construction phases. To facilitate field investigations and construction operations, index and chemical tests may be performed at either state NRCS facilities or commercial facilities. Laboratory tests for engineering properties (shear, consolidation, permeability, etc.) must be performed at accredited geotechnical laboratories supervised by engineers with geotechnical engineering expertise.

B. For designs prepared through engineering services contracts, the testing may be performed as a phase of the total design contract (see part 505 of this manual). Soil mechanics testing facilities may also use engineering services contracts with commercial geotechnical facilities to supplement their own forces, redistribute peak workloads, and provide more efficient operation. Testing by non-NRCS facilities must be reviewed and checked for accuracy and proper procedures by NRCS engineers with geotechnical engineering expertise.

C. NRCS soil mechanics testing services are provided through the National Design, Construction and Soil Mechanics Center Soil Mechanics Labs (NDCSMC-SML) in Lincoln, NE. The center has two testing laboratories available to perform testing services: the national laboratory located in Lincoln, NE, serves the States in the West Region, Northeast Region, northern States in the Central and Southeast Region; a satellite laboratory in Fort Worth, TX, serves the southern States in the Central and Southeast Regions. Figure 533-C1 shows which State each laboratory serves.

Figure 533-C1: Laboratory Facility Service Location

| State | Laboratory Location | State | Laboratory Location |
|---------------|----------------------------|---------------------|----------------------------|
| Alabama | Fort Worth, TX | Nevada | Lincoln, NE |
| Alaska | Lincoln, NE | New Hampshire | Lincoln, NE |
| Arizona | Lincoln, NE | New Jersey | Lincoln, NE |
| Arkansas | Fort Worth, TX | New Mexico | Lincoln, NE |
| California | Lincoln, NE | New York | Lincoln, NE |
| Colorado | Lincoln, NE | North Carolina | Fort Worth, TX |
| Connecticut | Lincoln, NE | North Dakota | Lincoln, NE |
| Delaware | Lincoln, NE | Ohio | Lincoln, NE |
| Florida | Fort Worth, TX | Oklahoma | Fort Worth, TX |
| Georgia | Fort Worth, TX | Oregon | Lincoln, NE |
| Hawaii | Lincoln, NE | Pennsylvania | Lincoln, NE |
| Idaho | Lincoln, NE | Rhode Island | Lincoln, NE |
| Illinois | Lincoln, NE | South Carolina | Fort Worth, TX |
| Indiana | Lincoln, NE | South Dakota | Lincoln, NE |
| Iowa | Lincoln, NE | Tennessee | Fort Worth, TX |
| Kansas | Lincoln, NE | Texas | Fort Worth, TX |
| Kentucky | Lincoln, NE | Utah | Lincoln, NE |
| Louisiana | Fort Worth, TX | Vermont | Lincoln, NE |
| Maine | Lincoln, NE | Virginia | Lincoln, NE |
| Maryland | Lincoln, NE | Washington | Lincoln, NE |
| Massachusetts | Lincoln, NE | West Virginia | Lincoln, NE |
| Michigan | Lincoln, NE | Wisconsin | Lincoln, NE |
| Minnesota | Lincoln, NE | Wyoming | Lincoln, NE |
| Mississippi | Fort Worth, TX | Pacific Basin | Lincoln, NE |
| Missouri | Lincoln, NE | Puerto Rico | Fort Worth, TX |
| Montana | Lincoln, NE | U.S. Virgin Islands | Fort Worth, TX |
| Nebraska | Lincoln, NE | | |

D. Both facilities have the equipment and NRCS personnel to run all geotechnical tests routinely required for soil mechanics testing. The testing laboratories are managed under one co-director and either laboratory can provide testing services during peak workload periods.

E. NRCS laboratory testing services may be requested by letter or electronic mail. The request must include the name and address of sender, name of site or project, financial project code, name of watershed or location, type of project and brief description, list of samples and type (disturbed or undisturbed), hazard class (for dams), testing requested, and other pertinent information. More detailed directions, including information on sample size, shipping information, sample list form, and the testing request form can be downloaded from the NDCSMC-SML Web site. The center operates on its own budget and States are not charged for testing services or assistance. Testing is accomplished on a first-come, first-served basis.

F. If the NDCSMC-SMLs are to perform geotechnical engineering analyses, samples submitted must be accompanied by geologic and engineering reports that commensurate with the complexity of the structure. The reports must be submitted to the testing laboratory by the SCE or others with delegated authority from the SCE.

G. The engineering report must include the preliminary design and other information required for establishing a soil testing program, testing parameters, and other details for completing soil tests. The report must also explain the purpose for which samples were obtained, the potential use of the soil represented by the samples, and the expected use for the test results.

H. The SCE must maintain close contact with the testing facility when changes occur in the soil testing program. For projects requiring design assistance from other engineering staffs or teams, the SCE will keep that staff informed of any changes in the scope of the project and target dates which affect the completion of the testing.

I. The testing facility will submit a report to the SCE that includes all requested test data and a narrative giving details of the testing workload, soil classifications, descriptions of soils, condition of samples, and observed test performances.

J. NRCS soil mechanics testing facilities will comply with the requirements of the Animal and Plant Health Inspection Service when receiving or disposing of soil samples from areas where quarantine regulations are imposed. Each facility must obtain a permit for receiving these samples. Requirements for taking and shipping soil samples under quarantine regulations are included in part 531, subpart A, sections 531.2 F and G of this manual.

533.23 Geotechnical Engineering Analyses

A. Geotechnical engineering analyses must be made by the engineer closest to the field who has the necessary expertise in geotechnical engineering. If possible, this workload is scheduled concurrently with all stages of design and construction.

- (1) One staff engineer must be designated to provide geotechnical engineering leadership in each State that has a significant expertise in earth dam design or other activities requiring geotechnical engineering expertise. This engineer must be trained in geotechnical engineering principles and have an understanding of the behavior of soils under various conditions. Engineers with specialized training and broad experience are required to make judgments and analyses for structures that require extensive geotechnical engineering expertise, such as large earth dams and foundations with complex conditions.
- (2) States that do not have the necessary expertise may obtain assistance from another State within their region, a multistate design staff, an outside source, or NDCSMC-SML staff.

B. If geotechnical engineering analyses by the NDCSMC-SMLs are requested in conjunction with the soil mechanics testing, the SCE will arrange for the assistance and analyses (see section 533.23A of this subpart). The engineer responsible for the analyses must participate in all the geotechnical

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engineering phases of investigation, soil testing, design, and soil-related problems during construction.

C. The geotechnical engineering analyses report will be provided to the SCE as part of the soil mechanics report including the documenting site conditions, preliminary design assumptions, engineering properties of soils used in the analyses, and other factors pertinent to the design and construction of the project. Appropriate recommendations for design features will also be included in the report.

D. If geotechnical investigations, sampling, testing, or geotechnical engineering analyses are performed by local sponsoring agencies or consultants, the SCE will forward the results to NRCS personnel that have the necessary expertise to ensure that standards and specifications are met. States that regularly request geotechnical engineering assistance from the NDCSMC-SML or another State on designs completed by in-State NRCS personnel must also obtain NDCSMC-SML's or that State's assistance on preparing contracts and reviewing geotechnical engineering criteria completed by local sponsoring agencies or consultants.