

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

**GEOTECHNICAL ENGINEERING BUREAU
FOUNDATION DRILLING AND SAMPLING GUIDELINES**

I. Soil Surveys- Drilling, Sampling and Special Notes

A. Introduction

The subsurface exploration for a proposed roadway must be tailored to identify subsurface soils and features that will affect the construction and performance of the roadway. Prior to developing a subsurface investigation plan, the Engineer should have some idea what he is looking for in the investigation. A good way to learn about an area is to examine all available data concerning the site. Good sources of information include:

- Topographic maps
- Aerial photos
- Existing boring data
- Examine roadway cuts in the area
- Geologic reports of the area
- Experience with soils in the area by DOT Geotechnical Engineers

While looking at this information the engineer needs to answer the following questions:

- Do you anticipate encountering rock?
- Is the area in a Karst formation?
- Do you anticipate slope stability issues?
- Do you anticipate corrosive soils?
- Do you anticipate very soft, compressible soils?
- What variations in soil types do you anticipate?

This information will assist the engineer in defining the type and intensity of drilling and sampling that he needs in the subsurface investigation plan.

The Georgia DOT has developed these drilling and sampling guidelines, which have been used by their drill crews for over 30 years. In some cases these guidelines are very conservative and in some cases the guidelines do not fully address the engineer's need for enough information. It must be remembered that the drill crews were using these guidelines without the direct assistance of a Geotechnical engineer. In view of this, the attached guidelines are provided as a general guideline for the Geotechnical engineer's exploration plan. We would anticipate some deviation from the guidelines based on the geology and consistency of the subsurface materials.

B. Cut Sections

1. Drilling Intervals

- a. On four-lane projects on new alignment, drill borings at the proposed centerline of each lane at 300-foot intervals along the project alignment. On four-lane undivided projects in areas of the state where soils are relatively consistent (especially in the Coastal Plain), the engineer may determine that borings only on the centerline may be needed. On two-lane projects on new alignment, drill borings only on the centerline. For road widening projects, drill in the center of the new lane(s).
- b. Drill to a depth of five feet below the proposed grade line. However, on projects that have side ditches in the Piedmont and Valley & Ridge Regions, where rock may be present in cuts, drill deep enough to also cover the ditchlines.
- c. When rock is encountered, drill borings at 100-foot intervals in the centerline and left and/or right ditchline(s). If the rock elevation is relatively uniform, continue with this interval. If rock elevations are not uniform, drilling at 50-foot intervals may be required. Contact the engineer for further instructions.
- d. Note if the rock is layered or weathered, if there are boulders or rock outcrops, and if drilling is hard or easy through the rock, or if practical refusal is reached.
- e. Estimate what will move the rock- a bulldozer, ripper, light blasting or heavy blasting.
- f. If large quantities of rock are found above grade on large areas of the project, notify the engineer immediately. (The project designer may consider raising the grade under certain conditions.) Some rock cores may be required by the engineer to determine if the rock slopes could be cut steeper than 2:1. Contact the engineer for further instructions.

2. Sampling Requirements

- a. At the first drilling interval, take a 15 to 20-pound bag sample at each different soil strata. Sample one side first, and if the material on the opposite side appears to be visually the same as at the first side, no additional sampling at that drilling interval will be necessary. Mark the samples to be tested for 810.2. See also item B.2.c below, however.

In addition, an experienced driller or engineer may determine that soils from subsequent borings are similar enough to the samples previously taken, and reduce the number of samples from subsequent locations. Other sources including geologic maps, previous test data, old reports, etc. should be consulted to help determine whether additional sampling and testing can be reduced.

- b. Take a split spoon sample at intervals of approximately every 1200 feet on the centerline at a depth of 0 to 2 feet below the proposed grade and store the sample in a sealed plastic bag. Mark the samples to be tested for moisture content and Unified classification.
- c. Take a minimum 40-pound bag sample at intervals of two per mile on the centerline at a depth of 0 to 2 feet below the proposed grade. Mark the samples to be tested for soil support and 810.2. The samples at these locations may be taken in lieu of those noted in section B.2.a.
- d. If the project is within any of the following counties, take several soil samples from deeper cuts, place in plastic bags and mark them to be tested for corrosion series: Bartow, Carroll, Cherokee, Fannin, Gilmer, Gordon, Haralson, Heard, Paulding, Pickens, and Polk.

3. Groundwater

- a. Note groundwater encountered during the drilling of all cuts. If none encountered, leave several drill holes unfilled but covered (for safety reasons), and make a 24-hour check of the groundwater table. Make a note what depth the groundwater was encountered and the time checked after drilling, or if no groundwater was found, or if the boring caved and what depth it caved at.
- b. If water is found flowing in side ditches along the roadway in any of the counties noted in section B.2.d, take several samples from different locations and mark them to be tested for corrosion series.

C. Fill Sections

1. Drilling Intervals

- a. On four-lane projects on new alignment, drill borings in between the break point and the toe of the slopes on the left and right sides at 500-foot intervals along the project alignment. If the project is a widening, drill only on the side(s) to be widened. If the project is a two-lane road on new alignment, drilling at the centerline may only be needed unless the fill heights result in a wide enough road footprint that two borings per station may be required. If the footprint exceeds approximately 150 feet wide, two borings may be required. Discuss with the engineer. Also consult other sources including geologic maps, previous test data, old reports, etc. to help determine whether one or two borings per station may be needed. The engineer may also provide guidelines for these situations.

In addition, if there are visible, significant changes in the material type that may cause settlement problems with the roadway, drill at a frequency sufficient to

represent the changes in material. If the project is only a bridge replacement or bridge widening with less than 500 feet of approach fills, make at least 2 borings on each side of the bridge.

- b. Drill to a depth of approximately 1 to 1½ times the maximum fill height at that station. However, if soft or unstable soils are found, drill to the bottom of these soils. (See also item C.1.c.)
- c. When muck (very soft, organic silty clay or plastic silt) or other areas of very soft soils are encountered, drill or probe with hand tools at 100-foot intervals on the centerline, left and right sides if the depth of the muck is relatively uniform. If not uniform, drill or probe at 50-foot intervals on the centerline, left and right sides. Notify the engineer of these areas as soon as possible, as Shelby tubes and vane shear or other in-place soil tests may be required.
- d. If any landfills or trash dumps are found on the proposed alignment, notify the engineer immediately.

2. Sampling Requirements

- a. Perform SPT sampling at each drilling interval. However, where fill heights are relatively low (less than about 6 to 10 feet), samples may be collected by hand auger or posthole. Probing may also be used to check for loose/soft soil conditions. USCS tests should be performed on select samples sufficient to represent the materials throughout the boring.
- b. If the project has few or no cut sections, take a minimum 40-pound bag sample at intervals of one per mile on the centerline. Mark the samples to be tested for soil support.
- c. If the project crosses areas of muck or very soft and/or wet soils, take several samples and store in a sealed plastic bag. Mark the samples to be tested for moisture content, organic content and Unified classification.

3. Groundwater

If the project crosses a lake, pond, swamp, or other inundated area, the bottom of these areas must be probed to check for soft material and several samples of the soils on the bottom taken. The samples should be stored in a plastic bag. Mark these samples to be tested for Unified classification.

D. Special Notes for All Projects

1. Make notes on any wells even if they are shown on the plans. Note the Station number, offset from centerline, size, approximate depth, type of well (drilled, brick-lined, concrete-lined, etc.) and the approximate water level.
2. If any landfills or trash dumps are found during drilling, notify the engineer immediately.

3. Make notes on any springs, even if they are shown on the plans. Note the Station number, offset from centerline, direction of flow and whether the spring appears to flow year round, or is a wet-weather spring only.
4. Note if there are any wet-weather ditches, swamps or low wet areas on the project alignment.
5. If soft soils are found at the bottom of cuts or on existing grade where fills will be placed, take Shelby tubes in these locations for settlement tests. Mark the tube with the project number and county, the boring number, the depth of the sample and the date.
6. If the project includes the construction of new pavement over existing paved shoulders, samples of the soils (from the subgrade level to two feet below subgrade) below the paved shoulder should be taken at every third drilling interval. The samples should be stored in a plastic bag, and marked to be tested for moisture content and Unified classification.
7. Note any heavily forested areas in which large amounts of soil stripping will be required.
8. Note the location of any trash piles, buildings or building foundations, caves or limesinks.
9. Note if the project will pass through residential or commercial areas which have buildings that will be relatively close to new construction, or buildings that are in poor condition that may be affected by vibrations from construction equipment.
10. Water samples should be taken on each project at stream crossings or large cross-drain pipes. Mark the samples to be tested for corrosion series. If the streambeds are dry, take a plastic bag sample, and mark it to be tested for corrosion series.
11. Note the size, type and condition of all cross-drain and other exposed pipes. Note also if the pipe is either partially or completely blocked by silt.
12. Note the type and condition of the pavement, and if there are any industries such as sawmills, truck stops, rock quarries, paper mills, etc. that would have frequent heavy truck traffic.
13. Record all information in a bound field book, and turn in the book with the project plans after completion.
14. Note any other problems or additional information that would be helpful in the foundation design or construction of the roadway.

E. Laboratory Testing

The primary testing of soil survey samples from cut sections is according to the series of tests indicated in Section 810.2 of the Standard Specifications book. These tests include:

- Nos. 60 and 200 sieve analysis
- Maximum dry density
- Volume change (shrinkage and swell)
- Percent clay

The primary testing of samples from fill sections is according to the Unified Series Classification System (USCS) which includes:

- Washed gradation over a series of sieves
- Plasticity Index (PI) tests

All samples are classified according to these parameters. Occasionally, the engineer may require that Plasticity Index tests be performed on selected samples from cut sections. Some of the other tests that may be performed on select disturbed samples include:

- Organic content
- In-place moisture content
- Corrosion series (pH and resistivity)
- Specific gravity

Depending on the sub-surface conditions and project requirements, some of the following undisturbed tests may also be required:

- Consolidation
- Triaxial
- Permeability
- Direct shear
- Rock compressive strength

These tests must be as directed by the engineer.