Subject: **CENTERLINE SOIL PROFILES AND STANDARD DESIGN PROCEDURES FOR CONSTRUCTION OF ROADWAYS THROUGH HIGH VOLUME CHANGE SOILS**

Effective Date: November 09, 2005
Issued Date: April 01, 2004

Supersedes S.O.P.	Dated
TMD-20-14-00-000	January 01, 1996

PURPOSE: To establish procedures and guidelines for conducting centerline soil profiles in accordance with ADM-02-21-00-000, to characterize the soil conditions along a proposed roadway centerline, and to specify treatment methods for high volume change soils.

1. GENERAL

The centerline soil profile and associated testing shall be a Type C Investigation as defined in ADM-02-21-00-000. The centerline soil profile shall provide classification and testing of the soils to identify the types of soil present along the roadway, evaluate their potential use as fill materials, and locate any undesirable high volume change or low strength surface soils which may require undercutting or other remedial measures during construction.

2. DEFINITIONS

2.1 High Volume Change Soil - A high volume change soil is defined as a soil having a volume change of 60 percent or higher when determined in accordance with AASHTO T 92 using the formula

$$VC = (w_1 - S) R$$

It is the intent of this procedure to establish the most economical means for controlling the problems associated with a shrinking and swelling soil. With this in mind, the replacement materials should always be the materials closest to the replacement site and possessing the highest CBR available. Controlling surface water is also a key feature in decreasing the harmful effects of shrinking and swelling soils. Other key features in design are good drainage ditch grades and an impermeable layer of soil over the high volume change clay.

2.2 Muck – A muck is defined as a saturated soil having an organic content of at least 6 percent as determined by Mississippi Test Method MT-29 or AASHTO T 267. The depth and extent of the muck shall be determined in the field to calculate the amount of material to be removed as muck excavation. Muck, having an organic content between 6 and 20 percent, may be tested for pH to determine whether it is suitable for use as plating or topsoil along the roadway. Muck having an organic content greater than 20 percent shall be wasted.

2.3 Unstable Soil – An unstable soil is defined as a soft, low CBR, saturated soil having an organic content less than 6 percent as defined by Mississippi Test Method MT-29 or AASHTO T 267. The depth and extent of the unstable soil shall be determined in the field to calculate the amount of material that must be removed as excess excavation.

3. SOIL PROFILE DEVELOPMENT

3.1 As soon as possible after completion of the centerline survey and establishment of the centerline profile grades, the District Laboratory shall complete soil borings to aid in the development of a centerline soil profile.

3.2 Boring spacing along the centerline of the survey shall be a maximum of 100 feet apart in cut sections and 200 feet apart in fill sections. For original soil profiles, it may be necessary to vary from these spacings due to field constraints (poor access, etc.), but every effort should be made to get representative samples from any omitted section as soon as field conditions permit.

3.3 Boring depths shall be a minimum of three (3) feet below the proposed subgrade elevation in the cut sections and at grade points. Boring depths shall be a minimum of three (3) feet below the existing ground surface for the fill sections.

3.4 The spacing and depth of the soil borings should vary if unusual conditions are encountered such as rock layers or weak deposits (muck or unstable soil). The auger method of drilling for disturbed samples is generally suitable for identification and testing; however, if it becomes apparent that adequate samples are not being obtained from the auger method, the Geotechnical Branch of Materials Division may be contacted to schedule a Type D investigation as defined in ADM-02-21-00-000.

3.4.1 When unusual soil conditions are encountered, such as rock, muck, or unstable soils, every effort shall be made to identify the limits of these soil conditions (lateral, horizontal, and vertical) beyond the usual samples taken at the regular drilling intervals. Contact the Geotechnical Branch if assistance is needed in determining these limits, or in determining possible construction alternatives for mitigating these conditions.

3.5 The borings, as nearly as possible, shall be sampled on one (1) foot intervals. From these samples the boring crew supervisor shall obtain a representative sample for each class soil encountered.

3.6 The boring crew supervisor shall prepare a boring log that describes and classifies the soil and lists the depth where changes occur.

3.7 Each day the boring crew supervisor shall obtain representative soil samples of each soil class encountered. These soil samples are to be used when the boring crew supervisor prepares the boring log for each boring. The boring crew supervisor should use extreme caution when obtaining representative soil samples, to insure that the samples are not contaminated. This is especially true when a sand or silt overlies a clay soil.

3.8 Each day the boring crew supervisor shall deliver the representative soil samples to the district laboratory for drying and testing. The samples shall be prepared for testing according to AASHTO T 87.

4. LABORATORY TESTING

4.1 Laboratory testing shall be conducted for the purpose of classifying each soil type in accordance with AASHTO M 145 and the Unified Soil Classification System.

4.2 As a minimum, the following tests and calculations shall be completed by the District Laboratory.

AASHTO T 11 – Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

AASHTO T 27 – Sieve Analysis of Fine and Coarse Aggregates

AASHTO T 87 – Dry preparation of Disturbed Soil and Soil Aggregate Samples for Test

AASHTO T 88 – Particle Size Analysis of Soils (with MT-23 Methods for Testing Soils)

AASHTO T 89 – Determination of the Liquid Limit of Soils

AASHTO T 90 – Determining the Plastic Limit and Plasticity Index of Soils

AASHTO T 92 – Determining the Shrinkage Factors of Soils

MT-30 – pH Determination

MT-47 – Soil Resistivity

Note: Additional test methods may be assigned by the District Materials Engineer as deemed necessary in preparing the centerline soil profile. The District Materials Engineer also shall have the discretion as to the necessity of running hydrometer analyses (T 88) on some types of soils, if it is certain that the test results would have no bearing as to the proper classification of the particular soil.

4.3 All test results shall be reported on form TMD-683.

5. FINAL REPORT

Annotations:
Commission Order:

The results of the centerline soil investigation shall be reported by the District Materials Engineer in the form of a report. The report shall contain the following:

Soil Profile – The soil profile shall be prepared on grid sheets with a logical horizontal and vertical scale to show the necessary detail. The soil profile shall clearly delineate differing soil types. Each soil type shall have an identification number to reference it to the laboratory test results, the AASHTO Classification, Unified Soils Classification, estimated CBR value, and Percent Volume Change (if applicable).

Laboratory Test Results – All test results shall be reported on TMD-683 clearly identifying the sample number, location, depth, Station Number, and date.

Conclusions and Recommendations – Areas along the roadway requiring special consideration during construction shall be delineated by Station and offset. As a minimum, the recommendations shall include areas that require undercut (or other construction considerations) due to the presence of high volume change clay, muck, or unstable material. Recommendations regarding cut and fill slopes in potentially unstable areas should be addressed. Additionally, recommendations as to type of chemical treatment of subgrades (soil-lime-water, lime-fly ash, or soil cement) should be delineated by Station limits.

Distribution of Report – Once the final report is complete, it shall be distributed by the District Materials Engineer according to the following schedule:

Original – On file in the District Materials Laboratory
Central Records (via 71-01) – 1 copy
District Engineer – 2 copies
Roadway Design Engineer – 4 copies
Bridge Engineer – 2 copies (when bridges are included)
State Construction Engineer – 1 copy
State Materials Engineer – 1 copy
Geotechnical Engineer – 1 copy

6. DESIGN IN AREAS OF HIGH VOLUME CHANGE SOILS

6.1 The District Materials Engineer will review and evaluate the soil profile along the project. By written report to Roadway Design Division, the location(s) of high volume change soil shall be delineated. Roadway Design Division shall prepare construction plans based on their review and these guidelines.

6.2 Cut slopes within high volume change soils shall be 6H:1V to minimize the risk of future slope failure.

6.3 Embankment slopes constructed with high volume change soils used as unclassified excavation shall be 5H:1V to minimize the risk of future slope failure.

6.4 The roadway section in areas delineated as containing high volume change soils shall be designed according to one of the two methods listed below.

6.4.1 Method 1 - Replacement Method

6.4.1.1 The Replacement Method shall be used where high volume change soils belong to the following geologic units. The Mississippi Office of Geology's *Geologic Map of Mississippi* shall be used for soil identification. Any questions concerning the geologic classification of the soil should be directed to the Geotechnical Branch of Materials Division.

Yazoo Clay Formation
Porters Creek Clay Formation
Zilpha Formation

Prairie Bluff Chalk Formation*
Ripley Formation*
Demopolis Chalk Formation*
Mooreville Chalk Formation*
Hattiesburg/Pascagoula Formation

***** These "Black Prairie" soils may be suitable for Method 2, at the District Materials Engineer's discretion, for alignments constructed parallel to existing roadways that exhibit no signs of active clays. **Unweathered chalk in the subgrade is not considered an active clay and generally requires no further processing under this SOP**.

6.4.1.2 The roadway typical section (cut or fill sections) shall be constructed in such a manner that the Design Soil (top 3 feet) contains no high volume change soil. The cut sections shall be undercut 3 feet below the profile grade and backfilled with select materials. The undercutting shall extend from ditchline to ditchline.

6.4.1.3 Material used as backfill within the Design Soil prism shall conform to one of the two types listed below. Suitable material that is to be excavated along the roadway alignment should be utilized where practical.

(a) Granular Material, Class 1 through Class 10, Group D or E

(b) Borrow Excavation, Classes B5-6, B6-6, B9-6, B15 or B16

6.4.1.4 The appropriate chemical treatment shall be established for the type of material used to replace the undercut sections.

6.4.2 Method 2 - Lime Treatment Method

6.4.2.1 High volume change soil areas not requiring Method 1 treatment shall be treated by soil-lime-water mixing.

6.4.2.2 The top 6 inches of the subgrade shall be treated with a Class A or Class B Lime Treatment (as determined by the Soils Laboratory of the Materials Division). The treatment shall extend from shoulder to shoulder so as not to interfere with pavement edge drains.

6.4.2.3 A base consisting of 6 inches of chemically treated granular material, or crushed stone, shall be placed over the lime treated subgrade as a portion of the pavement structure as soon as practical.