MISSISSIPPI DEPARTMENT OF TRANSPORTATION

Inter-Departmental Memorandum

TO: Roadway Design Section Engineers

DATE: November 12, 1996

FROM: Roadway Design Div. Engineer
Mr. Wendel T. Ruff

SUBJECT OR PROJECT NO: Right-of-way limits through high volume change soils

INFORMATION COPY TO:

COUNTY:

District Construction Engineers
Roadway Design Division
Construction Division
Materials Division
Central Files
CONSULTANTS

Attached, is a copy of S.O.P. #TMD-20-14-00-000, "Standard Procedures for Construction of Roadways Through High Volume Change Soils". Since September 1, 1991, when this S.O.P. was issued, Roadway Design Division has made every effort to comply with it. If it is impossible to meet it's requirements on a certain project, a variance from the Materials Division is requested.

As you are aware, all three of the accepted methods for treatment of high volume change soils require all fill slopes of 5H:1V or flatter, and all cut slopes to be 6H:1V or flatter. These flatter slopes are intended to assure long-term slope stability. However, right-of-way limits are often set, and on some occasions purchased, prior to the completion of the original soil profile. In turn, when high volume change soils are detected, the flatter slopes require additional right-of-way.

The purpose of this letter is to remind you of the following:

- Before setting right-of-way limits, the presence of high volume change soils should be considered;

- Whenever it is impossible to achieve the flatter slopes, a variance must be requested from the Materials Division. This request may be made by the District, as part of the pavement/grading recommendation.

Should additional information be deemed necessary, please advise.

Attachment

MISSISSIPPI DEPARTMENT OF TRANSPORTATION STANDARD OPERATING PROCEDURES			S.O.P. NO. TMD-20-14-00-000 PAGE 1 OF 11
SUBJECT:	STANDARD DESIGN PROCEDURES FOR CONSTRUCTION OF ROADWAYS THROUGH HIGH VOLUME CHANGE SOILS		DISTRIBUTION A,D
EFFECTIVE JAN. 1, 1996	ISSUED JAN. 1, 1996	SUPERSEDES PAGE 1 OF 11 S.O.P. NO. TMD-20-14-00-000 EFFECTIVE SEPTEMBER 1, 1991	APPROVED

PURPOSE: To establish procedures and recommendations for constructing roadways through areas of high volume change soil.

1. General

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 $VC = (w_1 - S) R$. All the symbols listed here are defined in the referenced test method except w_1. In this test method, w_1 is defined as a given moisture content. For this S.O.P. the given moisture content is the liquid limit. It is the intent of this standard operating 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 material closest to the replacement site and possessing the highest CBR available.

Controlling surface water is a key feature in decreasing the harmful effects of shrinking and swelling soils. Some key features in design are good drainage ditch grades and an impermeable layer of soil over the high volume change clay.

2. Soil Profile

2.1 As soon as possible after completion of the centerline survey and stablishment of the centerline profile grade, the District Laboratory shall complete soil sampling borings to aid in the development of an original centerline soil profile.

2.2 Where possible, boring spacings along the centerline of the survey shall be 100 feet in cut sections and 200 feet in fill sections.

2.3 The boring depths shall be five (5) feet below the proposed finish grade for the cut sections and grade points. The boring depths shall be five (5) feet below the existing ground surface for the embankment sections.

2.4 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.

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

2.6 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.

2.7 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.

2.8 The following tests shall be completed to aid the district laboratory supervisor or his or her designated representative in classifying the soil samples by AASHTO M 145. In addition, the laboratory

supervisor or his or her designated representative shall classify the soil samples by the Unified Soil Classification method.

2.8.1 Amount of Material Finer Than 0.075mm (No. 200) Sieve in Aggregate, AASHTO: T 11.

2.8.2 Sieve Analysis of Fine and Coarse Aggregates, AASHTO: T 27.

2.8.3 Dry preparation of Disturbed Soil and Soil Aggregate Samples for Test, AASHTO: T 87.

2.8.4 Particle Size Analysis of Soils, AASHTO: T 88.

2.8.5 Determining the Liquid Limit of Soils, AASHTO: T 89.

2.8.6 Determining the Plastic Limit and Plasticity Index of Soils, AASHTO: T 90.

2.8.7 Determining the Shrinkage Factors of Soils, AASHTO: T 92.

2.8.8 In addition, the District Materials Engineer may assign other soil tests which he deems necessary in preparing an accurate original soil profile.

2.9 When all the soil boring logs and soil sample testing information is available, the District shall prepare a soil profile. The profile shall be prepared on grid sheets which have grid lines on one (1) tenth inch spacing. Each one (1) inch grid line shall be wider and darker. The profile scale shall be one (1) inch equal 100 feet along the centerline of survey and one (1) inch equal 10 feet on the vertical or boring depth scale. The scale can be changed if conditions warrant a smaller scale.

2.10 When the Distinct Materials Engineer has completed the original soil profile, the profiles shall be distributed according to the following schedule:

2.10.1 The original to the District Materials Engineer

2.10.2 One (1) copy to Central File (via 71-01)

2.10.3 Two (2) copies to the District Engineer

2.10.4 Four (4) copies to the Roadway Design Engineer

2.10.5 Two (2) copies to the Bridge Engineer (When bridges are included)

2.10.6 One (1) copy to the Construction Engineer

2.10.7 One (1) copy to the State Materials Engineer

2.10.8 One (1) copy to the Geotechnical Engineer

2.10.9 The District Materials Engineer shall advise the Roadway Design Engineer when high volume change soil exist along the roadway alignment. This shall be done by memorandum that list station limits of the high volume change soils.

3. Comparative Results

When an alignment parallels an existing pavement, it may be helpful to compare the performance of the existing pavements in determining the corrective action required for the high volume change soil. The following procedures will be considered a valid comparison. The District Materials Engineer shall be responsible for obtaining the data and making recommendations to the Roadway Design Engineer.

3.1 Obtain soil samples through the shoulders every 200 feet within the cut sections of the existing pavement. The sample depths should be at least 3 feet below the existing subgrade. Sampling should be performed at 1-foot intervals.

3.2 Determine the shrinkage characteristics by AASHTO: T 92.

3.3 Obtain soil samples every 200 feet within the cut roadway of the new lane. The depth of these samples should be five (5) feet below the finish grade for the new lane. Sampling should be performed at 1-foot intervals.

3.4 Determine the shrinkage characteristics by AASHTO: T 92.

3.5 If the volume change percentage for the new lane is less than the volume change for the existing pavement, or the volume change does not exceed the volume change of the existing lane by more than three (3) percent, the condition of the existing pavement can be used to judge whatever volume change control techniques are needed.

3.6 The samples must be taken and the tests performed in order for the comparison to be valid. Assumptions and speculation will not be considered for eliminating volume change control techniques.

4. Design

4.1 The District Materials Engineer will review and evaluate the soil profile along the project. By written report to Roadway Design Division, he shall list the location(s) of high volume change soils. This report shall contain a discussion of the performance of any existing facilities, as outlined in Section 3.0, and the best method of treatment for the project.

4.2 The Roadway Design Engineer and his design representative shall review the district soil profile in conjunction with the written report from the District Materials Engineer to locate where volume change soils exist within the project limits. The Roadway Design Division shall prepare construction plans based on their review and these recommendations.

4.3 Cut slopes within high volume change soils shall be 6H:1V. The reason for doing this is to assure long-term slope stability.

4.4 Embankment slopes constructed with high volume change soils shall be 5H:1V. The reason for doing this is to assure long-term slope stability.

4.5 The roadway section where high volume change soils exist shall be designed according to one of the methods listed below. Method No. 1 is the preferred method for treatment of high volume change

soils, however, there may be areas where this method is prohibitive due to non-availability of suitable borrow material.

4.5.1 Method No. 1 - **Replacement Method.**

4.5.1.1 The roadway embankment (cut and fill sections) shall be constructed in such a manner that the Design Soil (top 3 ft.) contains no high volume change soil. The cut sections shall be undercut 3-feet deep and backfilled with approved borrow material. The undercutting shall extend from ditchline to ditchline.

4.5.1.2 Material for use in constructing the embankment Design Soil and for backfilling the undercut sections shall conform to either of the following classes. Cut excavation haul should be arranged to take advantage of suitable borrow material within the project alignment.

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

(b) Borrow Excavation, Classes B5-6, B6-6, B9-6, B-15 or B-16.

4.5.2 Method No. 2 - **Moisture Barrier Method.** (NOTE: This method is not to be used in cut sections in which the ditch grades are less than 0.5%, unless underdrains are provided at the ditch line to drain the subbase.)

4.5.2.1 The subgrade shall be undercut 18" at the centerline and 12 inches at the ditchline. The undercut subgrade crown shall be covered with an approved moisture barrier membrane. The membrane shall extend from ditchline to ditchline. The membrane shall consist of two outer layers of non-woven geotextile fabric with an inner layer of rubberized asphalt bonded to form a monolithic structure. The membrane shall conform to the material requirements as set out in the contract.

The membrane shall be joined by lapping 18-inches. The laps shall be positioned so that a roof like structure is formed on all downhill grades. Joining the membrane by sewing will not be permitted.

4.5.2.2 A subbase, consisting of Granular Material with a Group A designation, shall be placed and compacted on the membrane as soon as possible after placement of the membrane. The subbase material shall be backdumped and spread to prevent damaging the membrane.

4.5.3 Method No. 3 - **Lime Treatment Method** (NOTE: This method is not to be used in the Yazoo Clay Formation.)

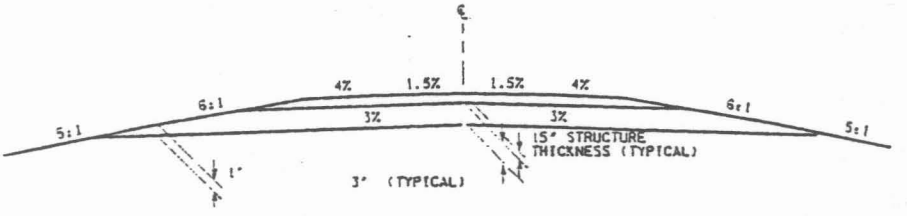
4.5.3.1 The top 8-inches of the subgrade shall be treated with a Class B Lime Treatment using 3.75 lbs. hydrated lime per sq. yd. per 1-inch depth. The treatment shall extend from the 6:1 slope on the left to the 6:1 slope on the right.

4.5.3.2 A subbase, consisting of 6 inches of granular material with a Group E designation shall be placed over the lime treated subgrade as a portion of the pavement structure.

4.5.3.3 The Yazoo Clay Formation shall be treated by Methods 1 or 2.

4.6 If the high volume change soil problems have not been corrected during a grading project, it may be necessary to deviate from the sections shown to avoid excessive expense (e.g., removing paved ditches and other structures). In this case, those responsible for design shall develop the best techniques available for correcting the high volume change problems.

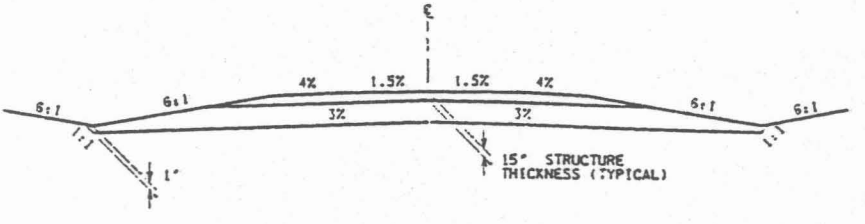
EMBANKMENT MATERIAL SPECIFICATIONS
SAME AS FOR FOUR LANE FACILITY



TYPICAL SECTION FOR EMBANKMENT
HIGH VOLUME CHANGE SOIL
TWO LANE FACILITY

6

BACKFILL MATERIAL SPECIFICATIONS
SAME AS FOR FOUR LANE FACILITY



TYPICAL SECTION FOR
UNDERCUTTING CUT SECTION
HIGH VOLUME CHANGE SOIL
TWO LANE FACILITY

METHOD I

MISSISSIPPI DEPARTMENT OF TRANSPORTATION
STANDARD OPERATING PROCEDURES

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DISTRIBUTION A,D

SUBJECT: STANDARD DESIGN PROCEDURES FOR CONSTRUCTION OF ROADWAYS THROUGH HIGH VOLUME CHANGE SOILS

APPROVED

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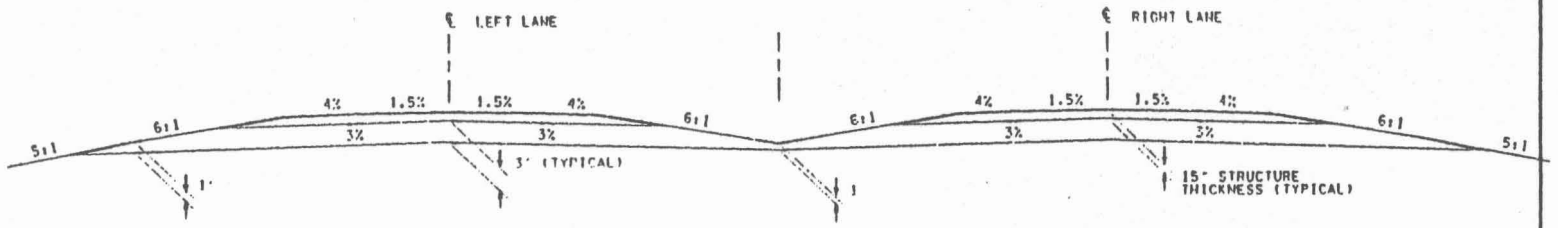
BEST EMBANKMENT MATERIAL ABOVE HIGH VOLUME CHANGE SOIL IS ANY CLASS 1 THROUGH CLASS 10, GROUP E GRANULAR MATERIAL

GOOD EMBANKMENT MATERIAL ABOVE HIGH VOLUME CHANGE SOIL IS BORROW EXCAVATION OR JOB SITE MATERIAL FOR CLASS B5-6, B9-6, B15 AND B16



TYPICAL SECTION FOR EMBANKMENT
HIGH VOLUME CHANGE SOIL
FOUR LANE FACILITY

BEST BACKFILL MATERIAL ABOVE HIGH VOLUME CHANGE SOIL IS ANY CLASS 1 THROUGH CLASS 10, GROUP E GRANULAR MATERIAL

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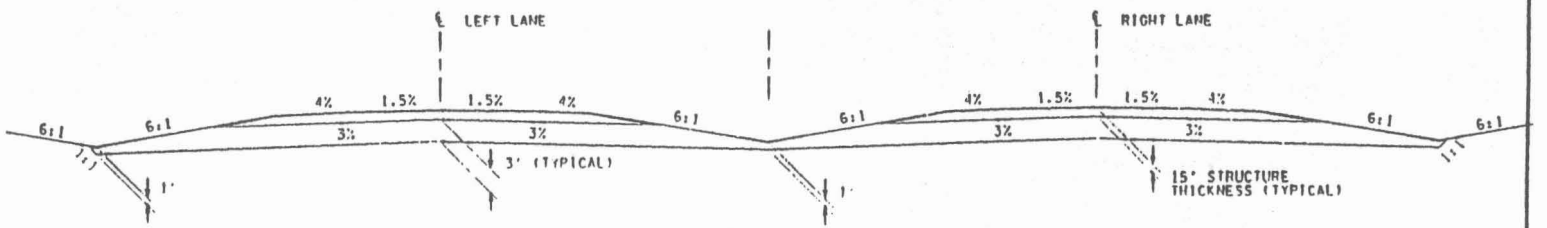
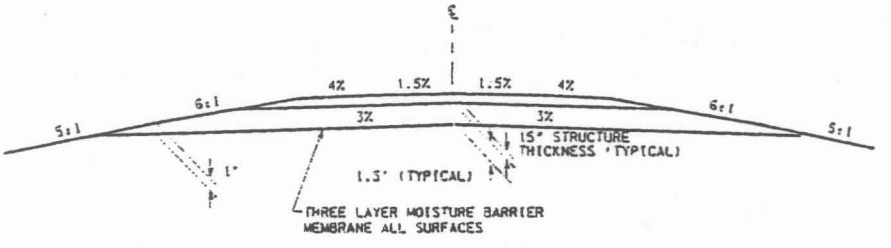


TYPICAL SECTION FOR
UNDERCUTTING CUT SECTION
HIGH VOLUME CHANGE SOIL
FOUR LANE FACILITY

METHOD 1

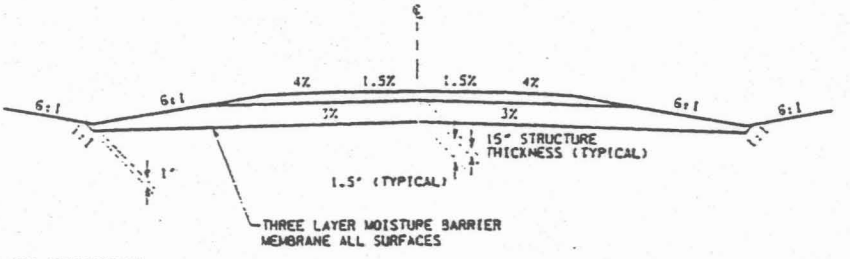
EMBANKMENT MATERIAL AND MOISTURE BARRIER MEMBRANE SPECIFICATIONS SAME AS FOR FOUR LANE FACILITY



TYPICAL SECTION FOR EMBANKMENT
HIGH VOLUME CHANGE SOIL USING MOISTURE
BARRIER MEMBRANE FOR TREATMENT
TWO LANE FACILITY

8

BACKFILL MATERIAL AND MOISTURE BARRIER MEMBRANE SPECIFICATIONS SAME AS FOR FOUR LANE FACILITY



UNDERDRAINS MUST BE PROVIDED AT THE DITCH LINE FOR DITCH GRADES LESS THAN 0.5%

TYPICAL SECTION FOR
UNDERCUTTING CUT SECTION
HIGH VOLUME CHANGE SOIL USING MOISTURE
BARRIER MEMBRANE FOR TREATMENT
TWO LANE FACILITY

METHOD 2

MISSISSIPPI DEPARTMENT OF TRANSPORTATION
STANDARD OPERATING PROCEDURES

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DISTRIBUTION A,D

SUBJECT: STANDARD DESIGN PROCEDURES FOR CONSTRUCTION OF ROADWAYS THROUGH HIGH VOLUME CHANGE SOILS

EFFECTIVE JAN. 1, 1996

ISSUED JAN. 1, 1996

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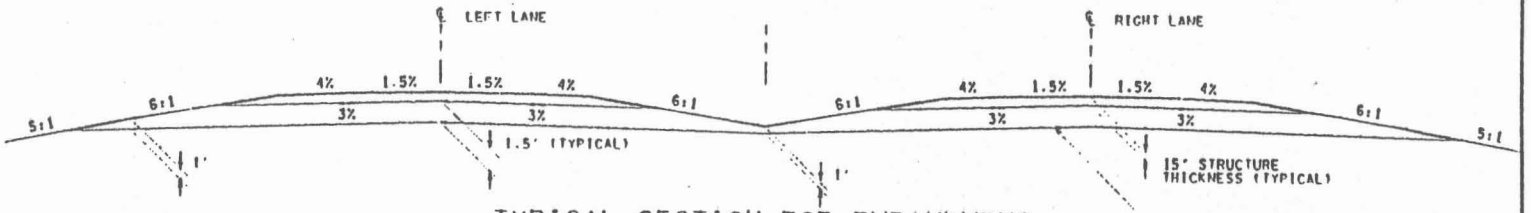
APPROVED

EMBANKMENT MATERIAL ABOVE MOISTURE BARRIER MEMBRANE SHALL BE ANY CLASS 1 THROUGH CLASS 10, GROUP A GRANULAR MATERIAL

ALL MOISTURE BARRIER MEMBRANE LAPS SHALL BE 1.5'. THE LAPS SHALL BE POSITIONED SO A ROOF-LIKE STRUCTURE WILL BE FORMED ON ALL DOWNHILL GRADES. SEWING OF THE FABRIC JOINTS WILL NOT BE PERMITTED.



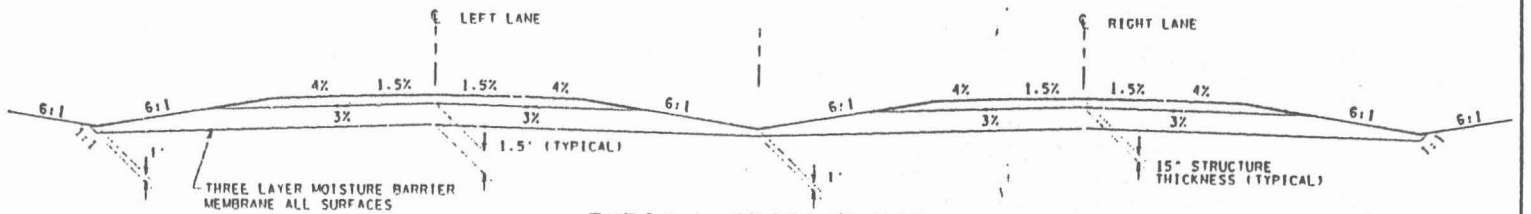
TYPICAL SECTION FOR EMBANKMENT
HIGH VOLUME CHANGE SOIL USING MOISTURE
BARRIER MEMBRANE FOR TREATMENT
FOUR LANE FACILITY

NOTE:

THE MOISTURE BARRIER MEMBRANE'S TWO OUTSIDE LAYERS SHALL BE NONWOVEN GEOTEXTILE FABRIC MEETING THE REQUIREMENTS FOR 714.13.3, 1996 SPECIFICATIONS. THE INNER LAYER SHALL BE A RUBBERIZED ASPHALT BONDED TO THE TWO OUTSIDE LAYERS FOR A WATERPROOF MONOLITHIC STRUCTURE.

BACKFILL MATERIAL ABOVE MOISTURE BARRIER MEMBRANE SHALL BE ANY CLASS 1 THROUGH CLASS 10, GROUP A GRANULAR MATERIAL

ALL MOISTURE BARRIER MEMBRANE LAPS SHALL BE 1.5'. THE LAPS SHALL BE POSITIONED SO A ROOF-LIKE STRUCTURE WILL BE FORMED ON ALL DOWNHILL GRADES. SEWING OF THE FABRIC JOINTS WILL NOT BE PERMITTED.

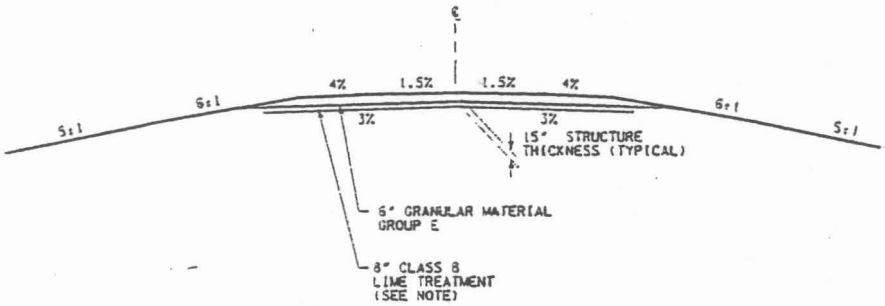


TYPICAL SECTION FOR
UNDERCUTTING CUT SECTION
HIGH VOLUME CHANGE SOIL USING MOISTURE
BARRIER MEMBRANE FOR TREATMENT
FOUR LANE FACILITY

METHOD 2

UNDERDRAINS MUST BE PROVIDED AT THE DITCH LINE FOR DITCH GRADES LESS THAN 0.5%

EMBANKMENT MATERIAL AND LIME AND BASE TREATMENT SPECIFICATIONS SAME AS FOR FOUR LANE FACILITY



TYPICAL SECTION FOR EMBANKMENT
HIGH VOLUME CHANGE SOIL
LIME AND BASE TREATMENT
TWO LANE FACILITY

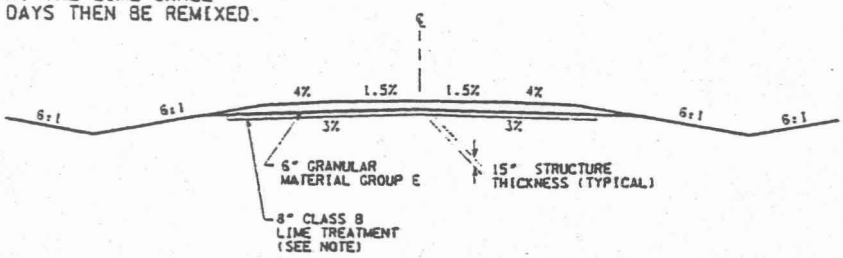
10

DO NOT USE
THESE SECTIONS ON
YAZOO CLAY

BACKFILL MATERIAL AND LIME AND BASE TREATMENT SPECIFICATIONS SAME AS FOR FOUR LANE FACILITY

NOTE:

LIME TREATMENT SHALL BE PLACED DURING GRADING PROJECT USING 3.75 LBS OF LIME PER SQ. YD PER INCH OF DEPTH. THE LIME SHALL CURE FOR 14 DAYS THEN BE REMIXED.



TYPICAL SECTION FOR BACKFILL
HIGH VOLUME CHANGE SOIL
LIME AND BASE TREATMENT
TWO LANE FACILITY

METHOD 3

MISSISSIPPI DEPARTMENT OF TRANSPORTATION
STANDARD OPERATING PROCEDURES

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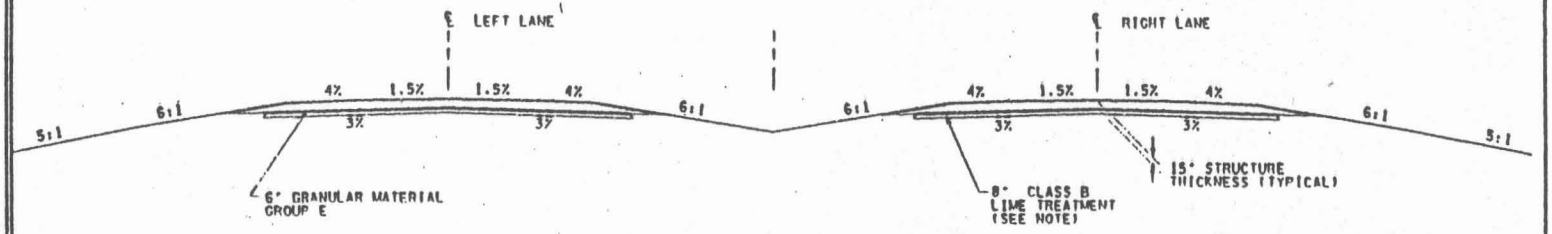
SUPERSEDES S.O.P. NO. TMD-20-14-00-000 PAGE 11 OF 11 EFFECTIVE SEPTEMBER 1, 1991



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LIME AND BASE TREATMENT
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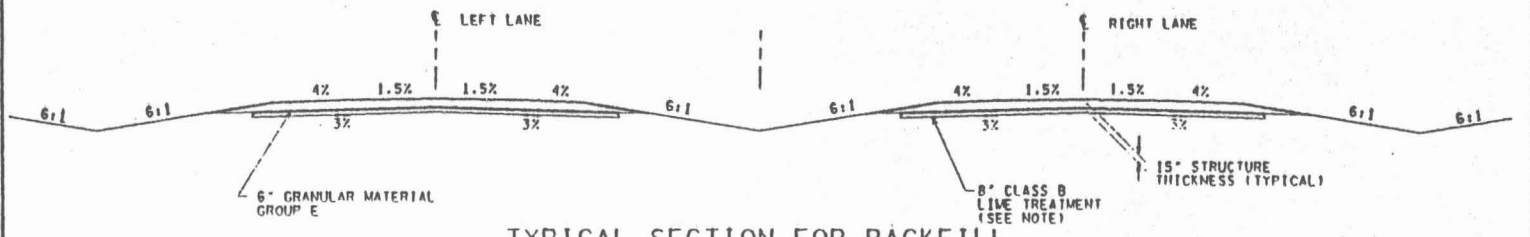

TYPICAL SECTION FOR BACKFILL
HIGH VOLUME CHANGE SOIL
LIME AND BASE TREATMENT
FOUR LANE FACILITY

METHOD 3