ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

# SUBSURFACE INVESTIGATION

STATE JOB NO. 040623

FEDERAL AID PROJECT NO. NHPP-0017(33)

NATURAL DAM-NORTH STRS. & APPRS. (S)

STATE HIGHWAY 59 SECTION 5

IN CRAWFORD COUNTY

LETTING OF AUGUST 10, 2016

The information contained herein was obtained by the Department for design and estimating purposes only. It is being furnished with the express understanding that said information does not constitute a part of the Proposal or Contract and represents only the best knowledge of the Department as to the location, character and depth of the materials encountered. The information is only included and made available so that bidders may have access to subsurface information obtained by the Department and is not intended to be a substitute for personal investigation, interpretation and judgment of the bidder. The bidder should be cognizant of the possibility that conditions affecting the cost and/or quantities of work to be performed may differ from those indicated herein.

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT**

May 15, 2014

**TO:** Mr. Trinity Smith, Engineer of Roadway Design

**SUBJECT:** Job No. 040623
Natural Dam - North Strs. & Apprs. (S)
Route 59 Section 5
Crawford County

Transmitted herewith is the requested Soil Survey, Strength Data and Resilient Modulus test results for the above referenced job. The project consists of replacing three bridges on Highway 59. Two of the bridges are on new location. Samples were obtained in the existing travel lanes, shoulders, ditch line and along the new location. Sample locations were measured from centerline of construction and should be noted as such on the logs.

Based on laboratory results of samples obtained, the subgrade soils consist primarily of low plasticity sandy clay with varying amounts of sandstone fragments. Cross-sections are not currently available but it is anticipated that the construction grade line will closely match that of the existing grade line. Rock was encountered at stations 102+00 at 4 feet, 13 feet, and 22 feet right of centerline at depths of 3.0 feet, 3.0 feet, and 2.5 feet respectively; and 201+00 5 feet right of centerline at a depth of 5.0 feet. The subgrade soils are expected to provide a stable working platform with conventional processing if the weather is favorable during construction.

Undercut requirements may vary based on seasonal conditions. If embankment is to be placed within the existing ditch line, the soft organic material should be undercut a maximum depth of two feet. Further recommendations will be made when plans are more developed and cross-sections become available.

Listed below is the additional information requested for use in developing the plans:

1. The Qualified Products List (QPL) indicates that Aggregate Base Course (Class CL-7) is available from commercial producers in the vicinity of Van Buren.

2. Asphalt Concrete Hot Mix

| Type | Asphalt Cement % | Mineral Aggregate % |
|---|---|---|
| Surface Course | 5.5 | 94.5 |
| Binder Course | 4.6 | 95.4 |
| Base Course | 4.1 | 95.9 |

Michael C. Benson
Materials Engineer

MCB:pt:bjj
Attachment
cc: State Constr. Eng. – Master File Copy
District 4 Engineer
Transportation Planning and Policy Div.
G. C. File

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
MICHAEL BENSON, MATERIALS ENGINEER
*** SOIL SURVEY STRENGTH TEST REPORT ***

DATE - 05/12/2014
JOB NUMBER - 040623

SEQUENCE NO. - 1
MATERIAL CODE - SSRVPS
SPEC. YEAR - 2003
SUPPLIER ID. - 1
COUNTY/STATE - 17
DISTRICT NO. - 04

JOB NAME - NATURAL DAM - NORTH STRS. & APPRS. (S)

| STATION LIMITS | R-VALUE AT 240 psi |
|---|---|
| BEGIN JOB - END JOB | 8 |
| RESILIENT MODULUS | |
| STA.101+00 | 8551 |
| STA.201+00 | 9006 |

REMARKS -
-

AASHTO TESTS : T190

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT
MATERIALS DIVISION

AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS
RECOMPACTED SAMPLES

| | | | |
|---|---|---|---|
| **Job No.** | 040623 | **Material Code** | SSRVPS |
| **Date Sampled:** | 5/8/14 | **Station No.:** | 110+00 |
| **Date Tested:** | May 8, 2014 | **Location:** | 20'LT |
| **Name of Project:** | NATURAL DAM-NORTH STRS. & APPRS (S) | | |
| **County:** | **Code:** 17 **Name:** CRAWFORD | | |
| **Sampled By:** | FAULKNER | **Depth:** | 0-5 |
| **Lab No.:** | 20141217 | **AASHTO Class:** | A-6(6) |
| **Sample ID:** | RV385 | **Material Type (1 or 2):** | 2 |
| **LATITUDE:** | | **LONGITUDE:** | |

**1. Testing Information:**

| | |
|---|---|
| Preconditioning - Permanent Strain > 5% (Y=Yes or N= No) | N |
| Testing - Permanent Strain > 5% (Y=Yes or N=No) | N |
| Number of Load Sequences Completed (0-15) | 15 |

**2. Specimen Information:**

| | |
|---|---|
| Specimen Diameter (in): | |
| Top | 3.94 |
| Middle | 3.93 |
| Bottom | 3.93 |
| Average | 3.93 |
| Membrane Thickness (in): | 0.01 |
| Height of Specimen, Cap and Base (in): | 8.04 |
| Height of Cap and Base (in): | 0.00 |
| Initial Length, Lo (in): | 8.04 |
| Initial Area, Ao (sq. in): | 12.08 |
| Initial Volume, AoLo (cu. in): | 97.10 |

**3. Soil Specimen Weight:**

| | |
|---|---|
| Weight of Wet Soil Used (g): | 3170.90 |

**4. Soil Properties:**

| | |
|---|---|
| Optimum Moisture Content (%): | 15.4 |
| Maximum Dry Density (pcf): | 110.8 |
| 95% of MDD (pcf): | 105.3 |
| In-Situ Moisture Content (%): | N/A |

**5. Specimen Properties:**

| | |
|---|---|
| Wet Weight (g): | 3170.90 |
| Compaction Moisture content (%): | 14.7 |
| Compaction Wet Density (pcf): | 124.43 |
| Compaction Dry Density (pcf): | 108.48 |
| Moisture Content After Mr Test (%): | 14.7 |

**6. Quick Shear Test (Y=Yes, N=No, N/A=Not Applicable):** #VALUE!

**7. Resilient Modulus, Mr:** 12227(Sc)^-0.25857(S3)^0.26469

**8. Comments** _____

**9. Tested By:** M.W. **Date:** May 8, 2014

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT**
**MATERIALS DIVISION**

**AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS**
**RECOMPACTED SAMPLES**

| | | | |
|---|---|---|---|
| **Job No.** | 040623 | **Material Code** | SSRVPS |
| **Date Sampled:** | 5/8/14 | **Station No.:** | 110+00 |
| **Date Tested:** | May 8, 2014 | **Location:** | 20'LT |
| **Name of Project:** | NATURAL DAM-NORTH STRS. & APPRS (S) | | |
| **County:** | **Code:** 17 **Name:** CRAWFORD | | |
| **Sampled By:** | FAULKNER | **Depth:** | 0-5 |
| **Lab No.:** | 20141217 | **AASHTO Class:** | A-6(6) |
| **Sample ID:** | RV385 | **Material Type (1 or 2):** | 2 |
| **LATITUDE:** | | **LONGITUDE:** | |

| PARAMETER | *Chamber Confining Pressure* | *Nominal Maximum Axial Stress* | *Actual Applied Max. Axial Load* | *Actual Applied Cyclic Load* | *Actual Applied Contact Load* | *Actual Applied Max. Axial Stress* | *Actual Applied Cyclic Stress* | *Actual Applied Contact Stress* | *Average Recov Def. LVDT 1 and 2* | *Resilient Strain* | *Resilient Modulus* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGNATION | $S_3$ | $S_{cyclic}$ | $P_{max}$ | $P_{cyclic}$ | $P_{contact}$ | $S_{max}$ | $S_{cyclic}$ | $S_{contact}$ | $H_{avg}$ | $\varepsilon_r$ | $M_r$ |
| UNIT | psi | psi | lbs | lbs | lbs | psi | psi | psi | in | in/in | psi |
| Sequence 1 | 6.0 | 2.0 | 24.8 | 22.1 | 2.7 | 2.1 | 1.8 | 0.2 | 0.00088 | 0.00011 | 16,728 |
| Sequence 2 | 6.0 | 4.0 | 46.8 | 44.1 | 2.7 | 3.9 | 3.6 | 0.2 | 0.00194 | 0.00024 | 15,130 |
| Sequence 3 | 6.0 | 6.0 | 68.7 | 65.2 | 3.5 | 5.7 | 5.4 | 0.3 | 0.00319 | 0.00040 | 13,583 |
| Sequence 4 | 6.0 | 8.0 | 90.6 | 84.6 | 5.9 | 7.5 | 7.0 | 0.5 | 0.00491 | 0.00061 | 11,472 |
| Sequence 5 | 6.0 | 10.0 | 112.4 | 104.1 | 8.3 | 9.3 | 8.6 | 0.7 | 0.00674 | 0.00084 | 10,277 |
| Sequence 6 | 4.0 | 2.0 | 24.8 | 22.1 | 2.7 | 2.1 | 1.8 | 0.2 | 0.00101 | 0.00013 | 14,565 |
| Sequence 7 | 4.0 | 4.0 | 46.4 | 43.6 | 2.8 | 3.8 | 3.6 | 0.2 | 0.00219 | 0.00027 | 13,270 |
| Sequence 8 | 4.0 | 6.0 | 67.0 | 64.2 | 2.8 | 5.6 | 5.3 | 0.2 | 0.00362 | 0.00045 | 11,820 |
| Sequence 9 | 4.0 | 8.0 | 89.0 | 83.9 | 5.1 | 7.4 | 6.9 | 0.4 | 0.00529 | 0.00066 | 10,555 |
| Sequence 10 | 4.0 | 10.0 | 110.8 | 103.2 | 7.6 | 9.2 | 8.5 | 0.6 | 0.00710 | 0.00088 | 9,683 |
| Sequence 11 | 2.0 | 2.0 | 24.6 | 21.9 | 2.7 | 2.0 | 1.8 | 0.2 | 0.00124 | 0.00015 | 11,768 |
| Sequence 12 | 2.0 | 4.0 | 45.8 | 43.1 | 2.7 | 3.8 | 3.6 | 0.2 | 0.00269 | 0.00034 | 10,646 |
| Sequence 13 | 2.0 | 6.0 | 66.2 | 63.5 | 2.7 | 5.5 | 5.3 | 0.2 | 0.00427 | 0.00053 | 9,897 |
| Sequence 14 | 2.0 | 8.0 | 86.8 | 82.6 | 4.2 | 7.2 | 6.8 | 0.3 | 0.00602 | 0.00075 | 9,132 |
| Sequence 15 | 2.0 | 10.0 | 108.8 | 102.1 | 6.7 | 9.0 | 8.5 | 0.6 | 0.00795 | 0.00099 | 8,551 |

TESTED BY M.W. DATE May 8, 2014

REVIEWED BY _____ DATE _____

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

MATERIALS DIVISION

AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS

RECOMPACTED / THINWALL TUBE SAMPLES

| | | | |
|---|---|---|---|
| **Job No.** | 040623 | **Material Code** | SSRVPS |
| **Date Sampled:** | 5/8/14 | **Station No.:** | 110+00 |
| **Date Tested:** | May 8, 2014 | **Location:** | 20'LT |
| **Name of Project:** | NATURAL DAM-NORTH STRS. & APPRS (S) | | |
| **County:** | **Code:** 17 **Name:** CRAWFORD | | |
| **Sampled By:** | FAULKNER | **Depth:** | 0-5 |
| **Lab No.:** | 20141217 | **AASHTO Class:** | A-6(6) |
| **Sample ID:** | RV385 | **Material Type (1 or 2):** | 2 |
| **LATITUDE:** | | **LONGITUDE:** | |

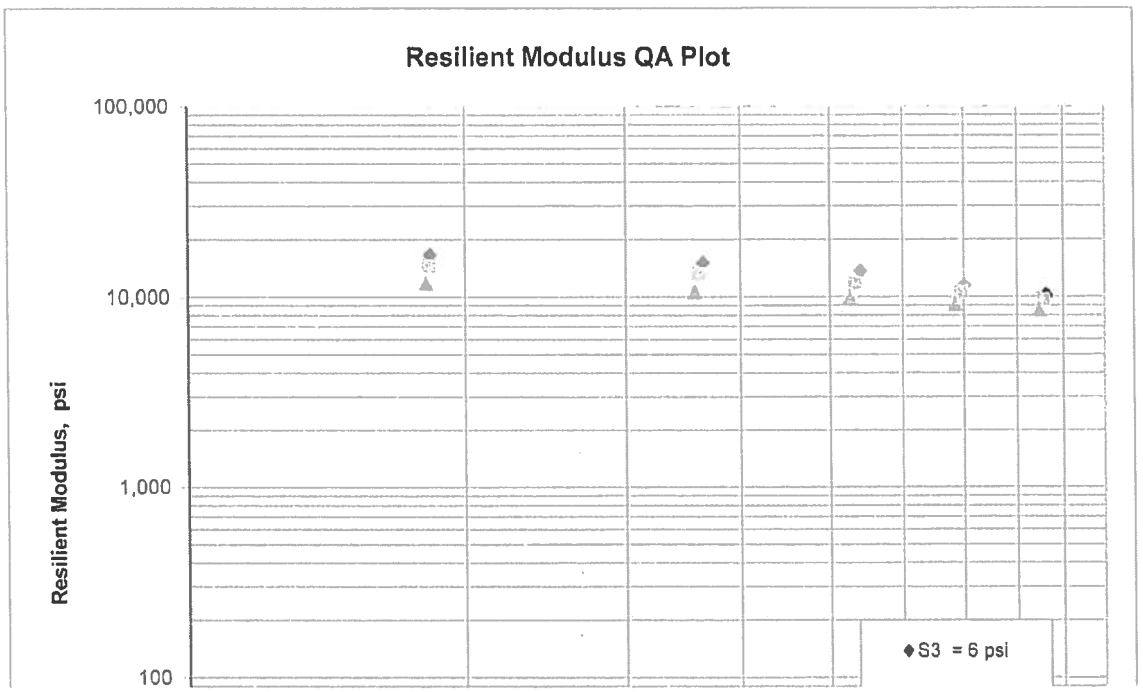
$$M_R = K1\,(S_C)^{K2}\,(S_3)^{K5}$$

K1 = 12,227

K2 = -0.25857

K5 = 0.26469

$R^2$ = 0.94



**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT**
**MATERIALS DIVISION**

**AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS**
**RECOMPACTED SAMPLES**

| | | | |
|---|---|---|---|
| **Job No.** | 040623 | **Material Code** | SSRVPS |
| **Date Sampled:** | 5/9/14 | **Station No.:** | 201+00 |
| **Date Tested:** | May 9, 2014 | **Location:** | 20'RT |
| **Name of Project:** | NATURAL DAM-NORTH STRS. & APPRS(S) | | |
| **County:** | **Code:** 17 **Name:** CRAWFORD | | |
| **Sampled By:** | FAULKNER | **Depth:** | 0-5 |
| **Lab No.:** | 20141218 | **AASHTO Class:** | A-4(0) |
| **Sample ID:** | RV386 | **Material Type (1 or 2):** | 2 |
| **LATITUDE:** | | **LONGITUDE:** | |

**1. Testing Information:**

| | |
|---|---|
| Preconditioning - Permanent Strain > 5% (Y=Yes or N= No) | N |
| Testing - Permanent Strain > 5% (Y=Yes or N=No) | N |
| Number of Load Sequences Completed (0-15) | 15 |

**2. Specimen Information:**

| | |
|---|---|
| Specimen Diameter (in): | |
| Top | 3.94 |
| Middle | 3.93 |
| Bottom | 3.95 |
| Average | 3.94 |
| Membrane Thickness (in): | 0.01 |
| Height of Specimen, Cap and Base (in): | 8.04 |
| Height of Cap and Base (in): | 0.00 |
| Initial Length, Lo (in): | 8.04 |
| Initial Area, Ao (sq. in): | 12.12 |
| Initial Volume, AoLo (cu. in): | 97.43 |

**3. Soil Specimen Weight:**

| | |
|---|---|
| Weight of Wet Soil Used (g): | 3252.20 |

**4. Soil Properties:**

| | |
|---|---|
| Optimum Moisture Content (%): | 11.2 |
| Maximum Dry Density (pcf): | 117.7 |
| 95% of MDD (pcf): | 111.8 |
| In-Situ Moisture Content (%): | N/A |

**5. Specimen Properties:**

| | |
|---|---|
| Wet Weight (g): | 3252.20 |
| Compaction Moisture content (%): | 11.0 |
| Compaction Wet Density (pcf): | 127.19 |
| Compaction Dry Density (pcf): | 114.58 |
| Moisture Content After Mr Test (%): | 10.9 |

**6. Quick Shear Test (Y=Yes, N=No, N/A=Not Applicable):** #VALUE!

**7. Resilient Modulus, Mr:** 8486(Sc)^-0.16851(S3)^0.50151

**8. Comments** _____

_____

**9. Tested By:** M.W. **Date:** May 9, 2014

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT**
**MATERIALS DIVISION**

**AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS**
**RECOMPACTED SAMPLES**

| | | | |
|---|---|---|---|
| **Job No.** | 040623 | **Material Code** | SSRVPS |
| **Date Sampled:** | 5/9/14 | **Station No.:** | 201+00 |
| **Date Tested:** | May 9, 2014 | **Location:** | 20'RT |
| **Name of Project:** | NATURAL DAM-NORTH STRS. & APPRS(S) | | |
| **County:** | **Code:** 17 **Name:** CRAWFORD | | |
| **Sampled By:** | FAULKNER | **Depth:** | 0-5 |
| **Lab No.:** | 20141218 | **AASHTO Class:** | A-4(0) |
| **Sample ID:** | RV386 | **Material Type (1 or 2):** | 2 |
| **LATITUDE:** | | **LONGITUDE:** | |

| PARAMETER | *Chamber Confining Pressure* | *Nominal Maximum Axial Stress* | *Actual Applied Max. Axial Load* | *Actual Applied Cyclic Load* | *Actual Applied Contact Load* | *Actual Applied Max. Axial Stress* | *Actual Applied Cyclic Stress* | *Actual Applied Contact Stress* | *Average Recov Def. LVDT 1 and 2* | *Resilient Strain* | *Resilient Modulus* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGNATION | $S_3$ | $S_{cyclic}$ | $P_{max}$ | $P_{cyclic}$ | $P_{contact}$ | $S_{max}$ | $S_{cyclic}$ | $S_{contact}$ | $H_{avg}$ | $\varepsilon_r$ | $M_r$ |
| UNIT | psi | psi | lbs | lbs | lbs | psi | psi | psi | in | in/in | psi |
| Sequence 1 | 6.0 | 2.0 | 25.2 | 22.7 | 2.6 | 2.1 | 1.9 | 0.2 | 0.00070 | 0.00009 | 25,249 |
| Sequence 2 | 6.0 | 4.0 | 47.1 | 44.6 | 2.5 | 3.9 | 3.7 | 0.2 | 0.00183 | 0.00023 | 16,144 |
| Sequence 3 | 6.0 | 6.0 | 69.3 | 65.9 | 3.4 | 5.7 | 5.4 | 0.3 | 0.00283 | 0.00035 | 15,425 |
| Sequence 4 | 6.0 | 8.0 | 92.7 | 86.9 | 5.8 | 7.7 | 7.2 | 0.5 | 0.00403 | 0.00050 | 14,297 |
| Sequence 5 | 6.0 | 10.0 | 116.4 | 108.0 | 8.3 | 9.6 | 8.9 | 0.7 | 0.00516 | 0.00064 | 13,886 |
| Sequence 6 | 4.0 | 2.0 | 24.7 | 22.1 | 2.6 | 2.0 | 1.8 | 0.2 | 0.00106 | 0.00013 | 13,839 |
| Sequence 7 | 4.0 | 4.0 | 45.8 | 43.2 | 2.7 | 3.8 | 3.6 | 0.2 | 0.00227 | 0.00028 | 12,598 |
| Sequence 8 | 4.0 | 6.0 | 67.2 | 64.5 | 2.7 | 5.5 | 5.3 | 0.2 | 0.00357 | 0.00044 | 11,983 |
| Sequence 9 | 4.0 | 8.0 | 90.9 | 85.8 | 5.1 | 7.5 | 7.1 | 0.4 | 0.00477 | 0.00059 | 11,944 |
| Sequence 10 | 4.0 | 10.0 | 114.4 | 106.9 | 7.5 | 9.4 | 8.8 | 0.6 | 0.00588 | 0.00073 | 12,067 |
| Sequence 11 | 2.0 | 2.0 | 24.1 | 21.4 | 2.7 | 2.0 | 1.8 | 0.2 | 0.00139 | 0.00017 | 10,220 |
| Sequence 12 | 2.0 | 4.0 | 44.6 | 41.8 | 2.8 | 3.7 | 3.4 | 0.2 | 0.00295 | 0.00037 | 9,382 |
| Sequence 13 | 2.0 | 6.0 | 65.1 | 62.2 | 2.8 | 5.4 | 5.1 | 0.2 | 0.00459 | 0.00057 | 9,006 |
| Sequence 14 | 2.0 | 8.0 | 87.4 | 83.1 | 4.4 | 7.2 | 6.9 | 0.4 | 0.00601 | 0.00075 | 9,173 |
| Sequence 15 | 2.0 | 10.0 | 110.7 | 103.9 | 6.7 | 9.1 | 8.6 | 0.6 | 0.00704 | 0.00088 | 9,791 |

TESTED BY M.W. DATE May 9, 2014

REVIEWED BY _____ DATE _____

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT**

**MATERIALS DIVISION**

**AASHTO T 307-99 - RESILIENT MODULUS OF SUBGRADE SOILS**

**RECOMPACTED / THINWALL TUBE SAMPLES**

| | | | |
|---|---|---|---|
| **Job No.** | 040623 | **Material Code** | SSRVPS |
| **Date Sampled:** | 5/9/14 | **Station No.:** | 201+00 |
| **Date Tested:** | May 9, 2014 | **Location:** | 20'RT |
| **Name of Project:** | NATURAL DAM-NORTH STRS. & APPRS(S) | | |
| **County:** | **Code:** 17 **Name:** CRAWFORD | | |
| **Sampled By:** | FAULKNER | **Depth:** | 0-5 |
| **Lab No.:** | 20141218 | **AASHTO Class:** | A-4(0) |
| **Sample ID:** | RV386 | **Material Type (1 or 2):** | 2 |
| **LATITUDE:** | | **LONGITUDE:** | |

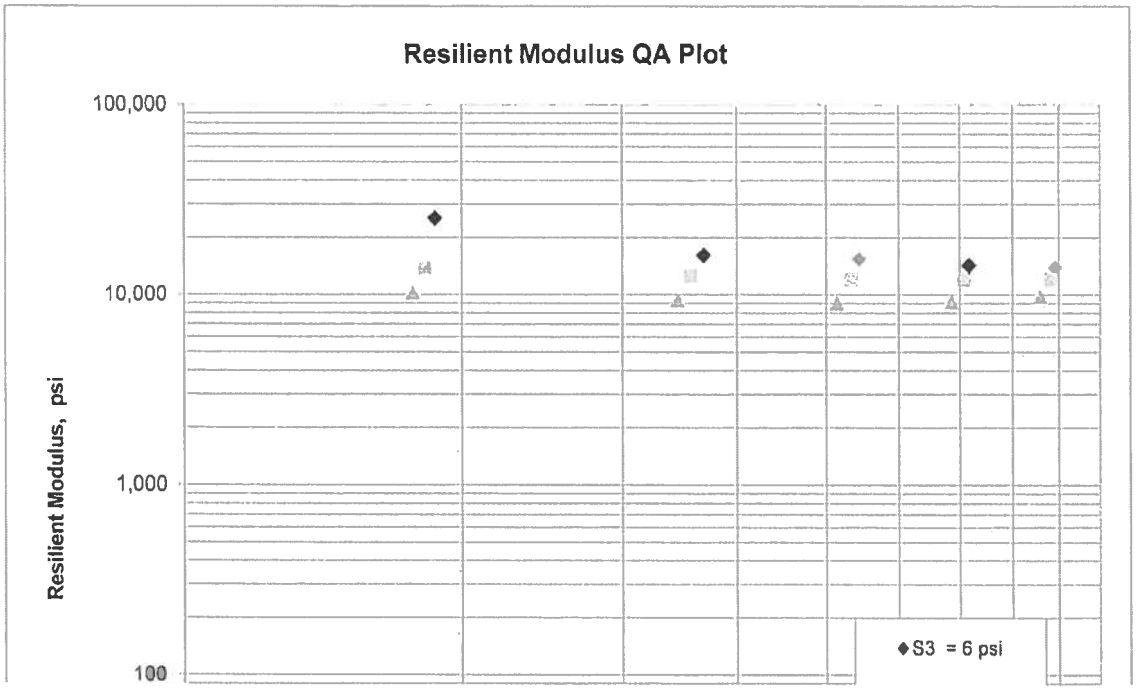
$$M_R = K1\,(S_C)^{K2}\,(S_3)^{K5}$$

K1 = 8,486

K2 = -0.16851

K5 = 0.50151

$R^2$ = 0.85



ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
MICHAEL BENSON, MATERIALS ENGINEER
*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE - 04/25/14
JOB NUMBER - 040623
FEDERAL AID NO.- TO BE ASSIGNED
PURPOSE - SOIL SURVEY SAMPLE
SPEC. REMARKS - NO SPECIFICATION CHECK
SUPPLIER NAME - STATE
NAME OF PROJECT - NATURAL DAM - NORTH STRS. & APPRS. (S)
PROJECT ENGINEER - NOT APPLICABLE
PIT/QUARRY - ARKANSAS
LOCATION - CRAWFORD, COUNTY
SAMPLED BY - S.FAULKNER
SAMPLE FROM - TEST HOLE
MATERIAL DESC. - SOIL SURVEY - R VALUE- PAVEMENT SOUNDINGS

SEQUENCE NO. - 1
MATERIAL CODE - SSRVPS
SPEC. YEAR - 2003
SUPPLIER ID. - 1
COUNTY/STATE - 17
DISTRICT NO. - 04

DATE SAMPLED - 04/08/14
DATE RECEIVED - 04/11/14
DATE TESTED - 04/22/14

| | | | |
|---|---|---|---|
| LAB NUMBER | 20141204 | 20141205 | 20141206 |
| SAMPLE ID | S372 | S373 | S374 |
| TEST STATUS | INFORMATION ONLY | INFORMATION ONLY | INFORMATION ONLY |
| STATION | 102+00 | 102+00 | 102+00 |
| LOCATION | 04RT | 13RT | 22RT |
| DEPTH IN FEET | 0-3Z | 0-3Z | 0-2.5Z |
| MAT'L COLOR | BROWN | BROWN | BROWN |
| MAT'L TYPE | | | |
| LATITUDE DEG-MIN-SEC | 35 39 31.30 | 35 39 31.20 | 35 39 31.20 |
| LONGITUDE DEG-MIN-SEC | 94 24 4.90 | 94 24 4.90 | 94 24 5.00 |
| % PASSING 2 IN. | | | |
| 1 1/2 IN. | | | |
| 3/4 IN. | | | 100 |
| 3/8 IN. | 100 | 100 | 99 |
| NO. 4 | 96 | 97 | 96 |
| NO. 10 | 90 | 88 | 90 |
| NO. 40 | 84 | 83 | 80 |
| NO. 80 | 79 | 79 | 74 |
| NO. 200 | 35 | 32 | 32 |
| LIQUID LIMIT | 21 | ND | ND |
| PLASTICITY INDEX | 04 | NP | NP |
| AASHTO SOIL | A-2-4(0) | A-2-4(0) | A-2-4(0) |
| UNIFIED SOIL | | | |
| % MOISTURE CONTENT | 22.5 | 23.3 | 22.6 |
| ACHMSC (IN) | 5.75W | 4.0W | -- |
| AGG.BASE CRS CL-7 (IN) | 5.0 | 5.0 | -- |

REMARKS - LOCATIONS MEASURED FROM C.L. OF CONSTRUCTION, W=MULTIPLE LAYERS,
- Z=AUGER REFUSAL

AASHTO TESTS : T24 T88 T89 T90 T265

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
MICHAEL BENSON, MATERIALS ENGINEER
*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE - 04/24/14
JOB NUMBER - 040623
FEDERAL AID NO.- TO BE ASSIGNED
PURPOSE - SOIL SURVEY SAMPLE
SPEC. REMARKS - NO SPECIFICATION CHECK
SUPPLIER NAME - STATE
NAME OF PROJECT - NATURAL DAM - NORTH STRS. & APPRS. (S)
PROJECT ENGINEER - NOT APPLICABLE
PIT/QUARRY - ARKANSAS
LOCATION - CRAWFORD, COUNTY
SAMPLED BY - S.FAULKNER
SAMPLE FROM - TEST HOLE
MATERIAL DESC. - SOIL SURVEY - R VALUE- PAVEMENT SOUNDINGS

SEQUENCE NO. - 2
MATERIAL CODE - SSRVPS
SPEC. YEAR - 2003
SUPPLIER ID. - 1
COUNTY/STATE - 17
DISTRICT NO. - 04

DATE SAMPLED - 04/08/14
DATE RECEIVED - 04/11/14
DATE TESTED - 04/22/14

| | | | |
|---|---|---|---|
| LAB NUMBER | 20141207 | 20141208 | 20141209 |
| SAMPLE ID | S375 | S376 | S377 |
| TEST STATUS | INFORMATION ONLY | INFORMATION ONLY | INFORMATION ONLY |
| STATION | 110+00 | 110+00 | 110+00 |
| LOCATION | 06LT | 14LT | 20LT |
| DEPTH IN FEET | 0-5 | 0-5 | 0-5 |
| MAT'L COLOR | BR/GR | BR/GR | BR/GR |
| MAT'L TYPE | | | |
| LATITUDE DEG-MIN-SEC | 35 39 25.30 | 35 39 25.40 | 35 39 25.40 |
| LONGITUDE DEG-MIN-SEC | 94 23 57.20 | 94 23 57.20 | 94 23 57.10 |
| % PASSING 2 IN. | | | |
| 1 1/2 IN. | 100 | | |
| 3/4 IN. | 95 | | |
| 3/8 IN. | 90 | 100 | 100 |
| NO. 4 | 81 | 94 | 95 |
| NO. 10 | 72 | 85 | 88 |
| NO. 40 | 63 | 75 | 82 |
| NO. 80 | 58 | 71 | 79 |
| NO. 200 | 43 | 58 | 74 |
| LIQUID LIMIT | 27 | 27 | 32 |
| PLASTICITY INDEX | 12 | 12 | 15 |
| AASHTO SOIL | A-6(2) | A-6(4) | A-6(9) |
| UNIFIED SOIL | | | |
| % MOISTURE CONTENT | 9.3 | 9.3 | 15.1 |
| ACHMSC (IN) | 7.0W | 3.0 | -- |
| AGG.BASE CRS CL-7 (IN) | 5.0 | 6.0 | -- |

REMARKS - LOCATIONS MEASURED FROM C.L. OF CONSTRUCTION, W=MULTIPLE LAYERS,
- Z=AUGER REFUSAL

AASHTO TESTS : T24 T88 T89 T90 T265

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
MICHAEL BENSON, MATERIALS ENGINEER
*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE - 04/25/14
JOB NUMBER - 040623
FEDERAL AID NO.- TO BE ASSIGNED
PURPOSE - SOIL SURVEY SAMPLE
SPEC. REMARKS - NO SPECIFICATION CHECK
SUPPLIER NAME - STATE
NAME OF PROJECT - NATURAL DAM - NORTH STRS. & APPRS. (S)
PROJECT ENGINEER - NOT APPLICABLE
PIT/QUARRY - ARKANSAS
LOCATION - CRAWFORD, COUNTY
SAMPLED BY - S.FAULKNER
SAMPLE FROM - TEST HOLE
MATERIAL DESC. - SOIL SURVEY - R VALUE- PAVEMENT SOUNDINGS

SEQUENCE NO. - 3
MATERIAL CODE - SSRVPS
SPEC. YEAR - 2003
SUPPLIER ID. - 1
COUNTY/STATE - 17
DISTRICT NO. - 04

DATE SAMPLED - 04/08/14
DATE RECEIVED - 04/11/14
DATE TESTED - 04/22/14

| | | | |
|---|---|---|---|
| LAB NUMBER | 20141210 | 20141211 | 20141212 |
| SAMPLE ID | S378 | S379 | S380 |
| TEST STATUS | INFORMATION ONLY | INFORMATION ONLY | INFORMATION ONLY |
| STATION | 201+00 | 201+00 | 201+00 |
| LOCATION | 05RT | 13RT | 20RT |
| DEPTH IN FEET | 0-5 | 0-5 | 0-5 |
| MAT'L COLOR | BR/GR | BR/GR | BR/GR |
| MAT'L TYPE | | | |
| LATITUDE DEG-MIN-SEC | 35 38 59.50 | 35 38 59.50 | 35 38 59.50 |
| LONGITUDE DEG-MIN-SEC | 94 23 40.30 | 94 23 40.40 | 94 23 40.50 |
| % PASSING 2 IN. | | | |
| 1 1/2 IN. | | | |
| 3/4 IN. | 100 | 100 | |
| 3/8 IN. | 99 | 99 | 100 |
| NO. 4 | 92 | 93 | 98 |
| NO. 10 | 83 | 86 | 95 |
| NO. 40 | 76 | 79 | 91 |
| NO. 80 | 68 | 71 | 85 |
| NO. 200 | 50 | 52 | 69 |
| LIQUID LIMIT | 17 | ND | 20 |
| PLASTICITY INDEX | 03 | NP | 05 |
| AASHTO SOIL | A-4(0) | A-4(0) | A-4(1) |
| UNIFIED SOIL | | | |
| % MOISTURE CONTENT | 12.8 | 14.6 | 21.4 |
| ACHMSC (IN) | 5.5W | 3.75W | -- |
| AGG.BASE CRS CL-7 (IN) | 8.0 | 8.0 | -- |

REMARKS - LOCATIONS MEASURED FROM C.L. OF CONSTRUCTION, W=MULTIPLE LAYERS,
- Z=AUGER REFUSAL

AASHTO TESTS : T24 T88 T89 T90 T265

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
MICHAEL BENSON, MATERIALS ENGINEER
*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE - 04/25/14
JOB NUMBER - 040623
FEDERAL AID NO.- TO BE ASSIGNED
PURPOSE - SOIL SURVEY SAMPLE
SPEC. REMARKS - NO SPECIFICATION CHECK
SUPPLIER NAME - STATE
NAME OF PROJECT - NATURAL DAM - NORTH STRS. & APPRS. (S)
PROJECT ENGINEER - NOT APPLICABLE
PIT/QUARRY - ARKANSAS
LOCATION - CRAWFORD, COUNTY
SAMPLED BY - S.FAULKNER
SAMPLE FROM - TEST HOLE
MATERIAL DESC. - SOIL SURVEY - R VALUE- PAVEMENT SOUNDINGS

SEQUENCE NO. - 4
MATERIAL CODE - SSRVPS
SPEC. YEAR - 2003
SUPPLIER ID. - 1
COUNTY/STATE - 17
DISTRICT NO. - 04

DATE SAMPLED - 04/08/14
DATE RECEIVED - 04/11/14
DATE TESTED - 04/22/14

| | | | |
|---|---|---|---|
| LAB NUMBER | 20141213 | 20141214 | 20141215 |
| SAMPLE ID | S381 | S382 | S383 |
| TEST STATUS | INFORMATION ONLY | INFORMATION ONLY | INFORMATION ONLY |
| STATION | 223+00 | 228+00 | 228+00 |
| LOCATION | CL | 05LT | 14LT |
| DEPTH IN FEET | 0-5 | 0-5 | 0-5 |
| MAT'L COLOR | BROWN | BROWN | BROWN |
| MAT'L TYPE | | | |
| LATITUDE DEG-MIN-SEC | 35 38 37.20 | 35 38 34.00 | 35 38 34.10 |
| LONGITUDE DEG-MIN-SEC | 94 23 31.70 | 94 23 29.50 | 94 23 29.40 |
| % PASSING 2 IN. | | | |
| 1 1/2 IN. | | | |
| 3/4 IN. | | | |
| 3/8 IN. | 100 | 100 | 100 |
| NO. 4 | 99 | 99 | 99 |
| NO. 10 | 99 | 96 | 97 |
| NO. 40 | 98 | 90 | 93 |
| NO. 80 | 82 | 74 | 78 |
| NO. 200 | 48 | 46 | 50 |
| LIQUID LIMIT | 22 | 21 | 21 |
| PLASTICITY INDEX | 08 | 08 | 07 |
| AASHTO SOIL | A-4(1) | A-4(1) | A-4(1) |
| UNIFIED SOIL | | | |
| % MOISTURE CONTENT | 16.8 | 15.5 | 15.7 |
| ACHMSC (IN) | -- | 7.25W | 5.0W |
| AGG.BASE CRS CL-7 (IN) | -- | 7.0 | 5.0 |

REMARKS - LOCATIONS MEASURED FROM C.L. OF CONSTRUCTION, W=MULTIPLE LAYERS,
- Z=AUGER REFUSAL

AASHTO TESTS : T24 T88 T89 T90 T265

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
MICHAEL BENSON, MATERIALS ENGINEER
*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE - 04/24/14
JOB NUMBER - 040623
FEDERAL AID NO.- TO BE ASSIGNED
PURPOSE - SOIL SURVEY SAMPLE
SPEC. REMARKS - NO SPECIFICATION CHECK
SUPPLIER NAME - STATE
NAME OF PROJECT - NATURAL DAM - NORTH STRS. & APPRS. (S)
PROJECT ENGINEER - NOT APPLICABLE
PIT/QUARRY - ARKANSAS
LOCATION - CRAWFORD, COUNTY
SAMPLED BY - S.FAULKNER
SAMPLE FROM - TEST HOLE
MATERIAL DESC. - SOIL SURVEY - R VALUE- PAVEMENT SOUNDINGS

SEQUENCE NO. - 5
MATERIAL CODE - SSRVPS
SPEC. YEAR - 2003
SUPPLIER ID. - 1
COUNTY/STATE - 17
DISTRICT NO. - 04

DATE SAMPLED - 04/08/14
DATE RECEIVED - 04/11/14
DATE TESTED - 04/22/14

| | | | |
|---|---|---|---|
| LAB NUMBER | 20141216 | | |
| SAMPLE ID | S384 | | |
| TEST STATUS | INFORMATION ONLY | | |
| STATION | 228+00 | | |
| LOCATION | 22LT | | |
| DEPTH IN FEET | 0-5 | | |
| MAT'L COLOR | BROWN | | |
| MAT'L TYPE | | | |
| LATITUDE DEG-MIN-SEC | 35 38 34.10 | | |
| LONGITUDE DEG-MIN-SEC | 94 23 29.30 | | |
| % PASSING 2 IN. | | | |
| 1 1/2 IN. | | | |
| 3/4 IN. | | | |
| 3/8 IN. | 100 | | |
| NO. 4 | 97 | | |
| NO. 10 | 95 | | |
| NO. 40 | 91 | | |
| NO. 80 | 75 | | |
| NO. 200 | 46 | | |
| LIQUID LIMIT | 21 | | |
| PLASTICITY INDEX | 06 | | |
| AASHTO SOIL | A-4(0) | | |
| UNIFIED SOIL | | | |
| % MOISTURE CONTENT | 15.2 | | |
| ACHMSC (IN) | -- | | |
| AGG.BASE CRS CL-7 (IN) | -- | | |

REMARKS - LOCATIONS MEASURED FROM C.L. OF CONSTRUCTION, W=MULTIPLE LAYERS
- Z=AUGER REFUSAL

AASHTO TESTS : T24 T88 T89 T90 T265

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT - LITTLE ROCK, ARKANSAS
MATERIALS DIVISION
MICHAEL BENSON, MATERIALS ENGINEER
*** SOIL SURVEY / PAVEMENT SOUNDING TEST REPORT ***

DATE - 04/24/14
JOB NUMBER - 040623
FEDERAL AID NO.- TO BE ASSIGNED
PURPOSE - SOIL SURVEY SAMPLE
SPEC. REMARKS - NO SPECIFICATION CHECK
SUPPLIER NAME - STATE
NAME OF PROJECT - NATURAL DAM - NORTH STRS. & APPRS. (S)
PROJECT ENGINEER - NOT APPLICABLE
PIT/QUARRY - ARKANSAS
LOCATION - CRAWFORD, COUNTY
SAMPLED BY - S.FAULKNER
SAMPLE FROM - TEST HOLE
MATERIAL DESC. - SOIL SURVEY - RESISTANCE R-VALUE ACTUAL RESULTS

SEQUENCE NO. - 1
MATERIAL CODE - RV
SPEC. YEAR - 2003
SUPPLIER ID. - 1
COUNTY/STATE - 17
DISTRICT NO. - 04

DATE SAMPLED - 04/08/14
DATE RECEIVED - 04/11/14
DATE TESTED - 04/22/14

| | | |
|---|---|---|
| LAB NUMBER | 20141217 | 20141218 |
| SAMPLE ID | RV385 | RV386 |
| TEST STATUS | INFORMATION ONLY | INFORMATION ONLY |
| STATION | 110+00 | 201+00 |
| LOCATION | 20LT | 20RT |
| DEPTH IN FEET | 0-5 | 0-5 |
| MAT'L COLOR | BR/GR | BR/GR |
| MAT'L TYPE | | |
| LATITUDE DEG-MIN-SEC | 35 39 25.40 | 35 38 59.50 |
| LONGITUDE DEG-MIN-SEC | 94 23 57.10 | 94 23 40.50 |
| % PASSING 2 IN. | | |
| 1 1/2 IN. | 100 | 100 |
| 3/4 IN. | 85 | 66 |
| 3/8 IN. | 82 | 66 |
| NO. 4 | 75 | 61 |
| NO. 10 | 70 | 58 |
| NO. 40 | 65 | 55 |
| NO. 80 | 64 | 51 |
| NO. 200 | 57 | 39 |
| LIQUID LIMIT | 33 | 21 |
| PLASTICITY INDEX | 15 | 04 |
| AASHTO SOIL | A-6(6) | A-4(0) |
| UNIFIED SOIL | | |
| % MOISTURE CONTENT | | |

REMARKS - LOCATIONS MEASURED FROM C.L. OF CONSTRUCTION

AASHTO TESTS : T24 T88 T89 T90 T265

JOB: **040623**

JOB NAME: **NATURAL DAM - NORTH STRS. & APPRS. (S)**

COUNTY NO. **17** DATE TESTED **4/22/2014**

**Arkansas State Highway Transporation Department**

*Materials Division*

*Michael Benson, Materials Engineer*

| STA.# | LOC. | DEPTH | COLOR | #4 | #10 | #40 | #80 | #200 | L.L. | P.I. | SOIL CLASS | LAB #: | %MOISTURE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | S | I | E | V | E S | | | | | |
| 110+00 | 20LT | 0-5 | BR/GR | 75 | 70 | 65 | 64 | 57 | 33 | 15 | A-6(6) | RV385 | |
| 201+00 | 20RT | 0-5 | BR/GR | 61 | 58 | 55 | 51 | 39 | 21 | 04 | A-4(0) | RV386 | |
| 102+00 | 04RT | 0-3Z | BROWN | 96 | 90 | 84 | 79 | 35 | 21 | 04 | A-2-4(0) | S372 | 22.5 |
| 102+00 | 13RT | 0-3Z | BROWN | 97 | 88 | 83 | 79 | 32 | ND | NP | A-2-4(0) | S373 | 23.3 |
| 102+00 | 22RT | 0-2.5Z | BROWN | 96 | 90 | 80 | 74 | 32 | ND | NP | A-2-4(0) | S374 | 22.6 |
| 110+00 | 06LT | 0-5 | BR/GR | 81 | 72 | 63 | 58 | 43 | 27 | 12 | A-6(2) | S375 | 9.3 |
| 110+00 | 14LT | 0-5 | BR/GR | 94 | 85 | 75 | 71 | 58 | 27 | 12 | A-6(4) | S376 | 9.3 |
| 110+00 | 20LT | 0-5 | BR/GR | 95 | 88 | 82 | 79 | 74 | 32 | 15 | A-6(9) | S377 | 15.1 |
| 201+00 | 05RT | 0-5 | BR/GR | 92 | 83 | 76 | 68 | 50 | 17 | 03 | A-4(0) | S378 | 12.8 |
| 201+00 | 13RT | 0-5 | BR/GR | 93 | 86 | 79 | 71 | 52 | ND | NP | A-4(0) | S379 | 14.6 |
| 201+00 | 20RT | 0-5 | BR/GR | 98 | 95 | 91 | 85 | 69 | 20 | 05 | A-4(1) | S380 | 21.4 |
| 223+00 | CL | 0-5 | BROWN | 99 | 99 | 98 | 82 | 48 | 22 | 08 | A-4(1) | S381 | 16.8 |
| 228+00 | 05LT | 0-5 | BROWN | 99 | 96 | 90 | 74 | 46 | 21 | 08 | A-4(1) | S382 | 15.5 |
| 228+00 | 14LT | 0-5 | BROWN | 99 | 97 | 93 | 78 | 50 | 21 | 07 | A-4(1) | S383 | 15.7 |
| 228+00 | 22LT | 0-5 | BROWN | 97 | 95 | 91 | 75 | 46 | 21 | 06 | A-4(0) | S384 | 15.2 |

*comments:* LOCATIONS MEASURED FROM C.L. OF CONSTRUCTION, W=MULTIPLE LAYERS
Z=AUGER REFUSAL

*Monday, May 12, 2014*

**JOB:** 040623

**JOB NAME:** NATURAL DAM - NORTH STRS. & APPRS. (S)

**COUNTY NO.** 17

*Arkansas State Highway Transporation Department*

*Materials Division*

*Michael Benson, Materials Engineer*

**DATE TESTED**
4/22/2014

## PAVEMENT SOUNDINGS

| STA.# | LOC. | | |
|---|---|---|---|
| 102+00 | 04RT | ACHMSC | AGG.BASE CRS CL-7 |
| | | **5.75W** | **5.0** |
| 102+00 | 13RT | ACHMSC | AGG.BASE CRS CL-7 |
| | | **4.0W** | **5.0** |
| 102+00 | 22RT | ACHMSC | AGG.BASE CRS CL-7 |
| | | -- | -- |
| 110+00 | 06LT | ACHMSC | AGG.BASE CRS CL-7 |
| | | **7.0W** | **5.0** |
| 110+00 | 14LT | ACHMSC | AGG.BASE CRS CL-7 |
| | | **3.0** | **6.0** |
| 110+00 | 20LT | ACHMSC | AGG.BASE CRS CL-7 |
| | | -- | -- |
| 201+00 | 05RT | ACHMSC | AGG.BASE CRS CL-7 |
| | | **5.5W** | **8.0** |
| 201+00 | 13RT | ACHMSC | AGG.BASE CRS CL-7 |
| | | **3.75W** | **8.0** |
| 201+00 | 20RT | ACHMSC | AGG.BASE CRS CL-7 |
| | | -- | -- |
| 223+00 | CL | ACHMSC | AGG.BASE CRS CL-7 |
| | | -- | -- |
| 228+00 | 05LT | ACHMSC | AGG.BASE CRS CL-7 |
| | | **7.25W** | **7.0** |
| 228+00 | 14LT | ACHMSC | AGG.BASE CRS CL-7 |
| | | **5.0W** | **5.0** |
| 228+00 | 22LT | ACHMSC | AGG.BASE CRS CL-7 |
| | | -- | -- |

***comments:*** LOCATIONS MEASURED FROM C.L. OF CONSTRUCTION, W=MULTIPLE LAY
Z=AUGER REFUSAL

*Monday, May 12, 2014*

**ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT**

November 20, 2014

**TO:** Mr. Rick Ellis, Bridge Engineer

**SUBJECT:** Job No. 040623
Natural Dam – North Strs. & Apprs. (S)
Route 59 Section 5
Crawford County

Transmitted herewith are a brief summary of the geology and site conditions, D50 analysis test results, unconfined compressive strength results, and the logs of the borings conducted for the structures and approaches of the above referenced project. The samples obtained by the Standard Penetration Tests were brought to the laboratory and visually classified by experienced lab personnel to confirm the field identifications. The rock cores are available for inspection at the Materials Division.

Based on the depth at which bedrock was encountered, it is anticipated that all bents will be founded on piling. Preboring may be necessary in order to achieve minimum penetration requirements. However, spread footings may be considered and should be sized based on the values provided in Table 1.

TABLE 1 – Bearing Capacity Recommendations for Interior bents

| Foundation Description | Nominal Bearing Resistance (ksf) | Resistance Factor | Factored Bearing Resistance (ksf) |
|---|---|---|---|
| Spread Footings | 24.8 | 0.45 | 11 |

If you have any questions concerning these recommendations, please contact the Geotechnical Section.

Michael C. Benson
Materials Engineer

MCB:rpt

cc: State Construction Engineer - Master File Copy
District 4 Engineer
G.C. File

# GEOLOGY AND SITE CONDITIONS
## Job No. 040623

## Natural Dam – North Strs. & Apprs. (S)
## Crawford County
## Route 59 Section 5

### Site Conditions

The existing bridge crosses over Lee Creek and consists of 8 spans. The bents are composed of concrete wall piers on footings. The deck is constructed of concrete supported by 5 sets of steel beams, except for the northern two spans which are supported by steel trusses. The guardrail is composed of steel on the truss supported part of the bridge, and concrete on the rest of the bridge, with both steel with wooden posts leading up to the bridge. The north end of the bridge sits on a sandstone bluff. A plastic water line runs along the east side of the bridge and is buried north and south of the bridge parallel to the existing bridge. A buried telecommunication line parallels the east side of the roadway. Metal utility pipes run along the west side of the roadway. Power lines parallel the west side of the bridge, then cross the roadway at a diagonal north of the bridge. An intersecting set of power lines crosses the roadway just to the north of the bridge.

Leek Creek flows in a westerly direction. The channel banks are thickly lined with trees and brush, with pastureland beyond on the south and residences beyond (both sides of the roadway) on the north side of the channel. Sandstone is exposed on the east side of the roadway, on the north end of the bridge.

### Site Geology

The project alignment is located in the mapped outcrop of the Atoka Formation (Pa). The Atoka Formation is a sequence of marine, mostly tan to gray silty sandstones and grayish-black shales with some rare calcareous beds and siliceous shales. Locally, the Atoka contains discontinuous streaks of coal and coaly shale. The unit may reach up to 25,000 feet thick in the Ouachita Mountains; however, north of the Arkansas Valley, the thickness decreases rapidly and only in the southern Boston Mountains does the Atoka attain thicknesses greater than 1,500 feet. There are numerous northeast-southwest and east-west trending normal faults in the area. A fault is mapped just to the south of the existing bridge. There may be other unmapped faults in the area. On the south side of the channel, bedrock was encountered at depths of 8.3 to 19.0 feet below ground level.

**Subsurface Conditions**

Based on the results of the boring at station 213+39, the subsurface stratigraphy may be generalized as follows:

| | |
|---|---|
| 0 to 3.7 Feet: | Consists of moist, very dense, brown **sand with gravel (sandstone fragments)**. |
| 3.7 to 7.4 Feet: | Consists of brown and dark gray, slightly weathered, well cemented **sandstone** with fractured layers. |
| 7.4 to 18.2 Feet: | Consists of dark gray and brown, medium hard **shale with frequent weathered layers**. |
| 18.2 to 23 Feet: | Consists of interbedded gray, slightly weathered, cemented **sandstone** and brown and dark gray, weathered, medium hard **shale**. |
| 23 to 27.4 Feet: | Consists of brown and dark gray, slightly weathered, well cemented **sandstone with shale partings**. |

Based on the results of the borings at stations 214+83 to 219+44, the subsurface stratigraphy may be generalized as follows:

| | |
|---|---|
| 0 to 8.3 Feet: | Consists of moist to wet, medium dense to very dense, brown **sand with gravel (sandstone fragments)** to **sandstone cobbles and boulders**. |
| 8.3 to 19 Feet: | Varies from moist to wet, medium dense to very dense, brown **sand with gravel (sandstone fragments)** to **sandstone cobbles and boulders** to slightly weathered, medium hard **shale** to gray, slightly weathered, cemented **sandstone**. |
| 19 to 43.6 Feet: | Consists of gray, slightly weathered, cemented **sandstone** to **sandstone with dark gray shale partings**. |

# $D_{50}$ AGGREGATE ANALYSIS FOR SCOUR CALCULATIONS

| Job No. 040623 | | | | | |
|---|---|---|---|---|---|
| **Creek Name** | **Station** | **Sample Type** | **Location** | **Depth (FT)** | **Aggregate Size (D50) (IN)** |
| Lee Creek | 217+08 | Creek Bank | C.L. Construction | N/A | 0.110 |

# Rock Core Unconfined Compression Test Summary

Project Number: 040623
Project Name: Natural Dam - North
Date Tested: 11/7/2014

| Station | Location | Sample No. | Depth (ft) | Diameter (in) | Height (in) | Total Load (lbs) | Correction Factor | Stress (psi) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 213+39 | 10' LT | 1 | 12.0 | 1.7 | 3.75 | 20,680 | 1.000 | 9,110 | |
| 214+83 | C.L. | 2 | 13.5 | 1.75 | 3.65 | 4,830 | 1.000 | 2,004 | |
| 216+10 | 8' RT | 3 | 10.0 | 1.65 | 3.55 | 3,410 | 1.000 | 1,593 | |
| 217+08 | 1' LT | 4 | 10.5 | 1.65 | 5.35 | 1,960 | 1.000 | 916 | |
| 218+00 | 42' RT | 5 | 11.5 | 1.8 | 3.55 | 13,560 | 1.000 | 5,329 | |
| 218+86 | 8' LT | 6 | 11.0 | 1.7 | 3.60 | 9,500 | 1.000 | 4,185 | |
| 219+44 | 3' RT | 7 | 14.5 | 1.8 | 3.85 | 26,990 | 1.000 | 10,606 | |
| | | | | | | | | | |
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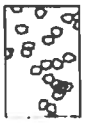
* Please note any broken samples, fractures or other characteristics of sample in Remarks.

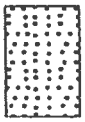
# LEGEND

## SOIL TYPES

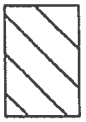
(SHOWN IN SYMBOL COLUMN)

(PREDOMINANT TYPE SHOWN HEAVY)


GRAVEL


SAND

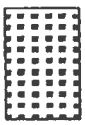

SILT

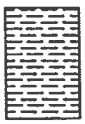

CLAY

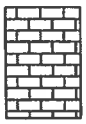

ORGANIC MATTER

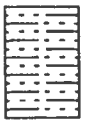
## ROCK TYPES

(SHOWN IN SYMBOL COLUMN)


SANDSTONE


SHALE or SILTSTONE


LIMESTONE or DOLOMITE


ALTERNATING LAYERS of SHALE and SANDSTONE


OTHER

## SAMPLER TYPES

(SHOWN IN SAMPLE COLUMN)

SHELBY TUBE


UNDISTURBED SAMPLE RECOVERY


DISTURBED SAMPLE RECOVERY


NO RECOVERY

SPLIT SPOON


SAMPLE RECOVERY


NO RECOVERY

ROCK CORING


% RECOVERY INDICATED ON LOGS

## TERMS DESCRIBING CONSISTENCY OR CONDITION

| GRANULAR SOIL | | CLAY | | CLAY-SHALE | | SHALE | |
|---|---|---|---|---|---|---|---|
| 'N' Value | Density | 'N' Value | Consistency | 'N' Value | Consistency | 'N' Value | Consistency |
| 0-4 | Very Loose | 0-1 | Very Soft | 0-1 | Very Soft | | |
| 5-10 | Loose | 2-4 | Soft | 2-4 | Soft | 31-60 | Soft |
| 11-30 | Medium Dense | 5-8 | Medium Stiff | 5-8 | Medium Stiff | Over 60 | |
| 31-50 | Dense | 9-15 | Stiff | 9-15 | Stiff | More than 2' | |
| Over 50 | Very Dense | 16-30 | Very Stiff | 16-30 | Very Stiff | Penetration | |
| | | 31-60 | Hard | 31-60 | Hard | in 60 Blows: | Medium Hard |
| | | Over 60 | Very Hard | Over 60 | Very Hard | Less than 2' | |
| | | | | | | Penetration | |
| | | | | | | in 60 Blows: | Hard |

1. Ground water elevations indicated on boring logs represent ground water elevations at date or time shown on boring log. Absence of water surface implies that no ground water data is available but does not necessarily mean that ground water will not be encountered at locations or within the vertical reaches of these borings.
2. Borings represent subsurface conditions at their respective locations for their respective depths. Variations in conditions between or adjacent to boring locations may be encountered.
3. Terms used for describing soils according to their texture or grain size distribution are in accordance with the Unified Soil Classification System.

Standard Penetration Test – Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and performing the test are recorded for each 6 inches of penetration on the drill log. The field "N" Value ($N_f$) can be obtained by adding the bottom two numbers for example: $\frac{6}{8-9} \Rightarrow 8+9=17 blows/ft$. The "N" Value corrected to 60% efficiency ($N_{60}$) can be obtained by multiplying $N_f$ by the hammer correction factor published on the boring log.

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 1
PAGE 1 OF 1

JOB NO. 040623 Crawford County
JOB NAME: Natural Dam - North Strs. & Apprs.
U.S. 59
STATION: 213+39
LOCATION: 10' Left of Center Line of Construction
LOGGED BY: Tracy Henderson

DATE: October 13, 2014
TYPE OF DRILLING: Hollow Stem Auger & Diamond Coring
EQUIPMENT: CME 75 w/ CME Automatic Hammer
HAMMER CORRECTION FACTOR: 1.37

COMPLETION DEPTH: 27.4

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 671.7 | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Moist, Very Dense, Brown Sand with Gravel (Sandstone Fragments) | | | | | | | | |
| 5 | | | SANDSTONE - Brown and Dark Gray, Thin Bedded, Slightly Weathered, Well-Cemented, with Slight Dip amd Fractured Layers | | | | | | 60 (1") | 94 | 0 |
| 10 | | | SHALE WITH FREQUENT WEATHERED SHALE LAYERS - Dark Gray and Brown, Laminated, Medium Hard, with Slight Dip | | | | | | | 76 | 10 |
| | | | SHALE - Brown and Dark Gray, Laminated, Highly Weathered, Medium Hard, with Slight Dip | | | | | | | | |
| 15 | | | SHALE WITH FREQUENT WEATHERED SHALE LAYERS - Dark Gray and Brown, Laminated, Medium Hard, with Slight Dip | | | | | | | 100 | 32 |
| 20 | | | SANDSTONE WITH OCCASIONAL DARK GRAY WEATHERED SHALE LAYERS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 28 |
| | | | SHALE - Brown and Dark Gray, Laminated, Weathered, Medium Hard, with Slight Dip | | | | | | | | |
| 25 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Brown and Dark Gray, Thick Bedded, Slightly Weathered, Well-Cemented, with Slight Dip | | | | | | | 100 | 68 |
| 30 | | | Boring Terminated | | | | | | | | |
| 35 | | | | | | | | | | | |

REMARKS:

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 2
PAGE 1 OF 1

JOB NO. 040623 Crawford County
JOB NAME: Natural Dam - North Strs. & Apprs.
U.S. 59
STATION: 214+83
LOCATION: Center Line of Construction
LOGGED BY: David Allen

DATE: October 27, 2014
TYPE OF DRILLING: Hollow Stem Auger & Diamond Coring
EQUIPMENT: CME 850 w/ CME Automatic Hammer
HAMMER CORRECTION FACTOR: 1.23

COMPLETION DEPTH: 29.8

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 636.3 | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | | Wet, Medium Dense, Brown Sand with Gravel (Sandstone Fragments) | | | | | | 6<br>8-12 | | |
| | | | Wet, Very Dense, Brown Sand with Gravel (Sandstone Fragments) | | | | | | 44<br>60<br>(2") | | |
| 10 | | | Sandstone Gravel and Cobbles | | | | | | | 78 | 0 |
| | | | SHALE - Dark Gray, Laminated, Slightly Weathered, Medium Hard, with Slight Dip | | | | | | | | |
| 15 | | | SANDSTONE WITH DARK GRAY SHALE SEAMS AND PARTINGS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 88 | 22 |
| 20 | | | SANDSTONE - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 70 |
| 25 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Thin Bedded, Slightly Weathered, Cemented, with Slight Dip and Fractured Layers | | | | | | | 100 | 0 |
| 30 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS AND OCCASIONAL LAYERS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 18 |
| 35 | | | Boring Terminated | | | | | | | | |

REMARKS:

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 3
PAGE 1 OF 1

JOB NO. 040623 Crawford County
JOB NAME: Natural Dam - North Strs. & Apprs.
U.S. 59
STATION: 216+10
LOCATION: 8' Right of Center Line of Construction
LOGGED BY: David Allen

DATE: October 28, 2014
TYPE OF DRILLING: Hollow Stem Auger & Diamond Coring
EQUIPMENT: CME 850 w/ CME Automatic Hammer
HAMMER CORRECTION FACTOR: 1.23

COMPLETION DEPTH: 33.1

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE ELEVATION: 637.5 | | | | | | | | |
| | | | Sandstone Gravel | | | | | | 6 / 7-4 | | |
| 5 | | X | | | | | | | | | |
| | | | SHALE - Gray and Brown, Weathered, Soft | | | | | | | | |
| | | | Sandstone Gravel and Cobbles | | | | | | | | |
| 10 | | | | | | | | | 60 (.01") | 100 | 71 |
| 15 | | | | | | | | | | 92 | 62 |
| 20 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 52 |
| 25 | | | | | | | | | | 100 | 32 |
| 30 | | | | | | | | | | 98 | 68 |
| | | | Boring Terminated | | | | | | | | |
| 35 | | | | | | | | | | | |

REMARKS:

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 4
PAGE 1 OF 1

JOB NO. 040623 Crawford County
JOB NAME: Natural Dam - North Strs. & Apprs.
U.S. 59
STATION: 217+08
LOCATION: 1' Left of Center Line of Construction
LOGGED BY: David Allen

DATE: October 22, 2014
TYPE OF DRILLING: Hollow Stem Auger & Diamond Coring
EQUIPMENT: CME 850 w/ CME Automatic Hammer
HAMMER CORRECTION FACTOR: 1.23

COMPLETION DEPTH: 28.5

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 636.0 | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | | Wet, Very Dense, Brown Sand with Gravel (Sandstone Fragments) | | | | | | 60 (2") | | |
| 10 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | 30 (.01") | 95 | 38 |
| 15 | | | SANDSTONE WITH OCCASIONAL POORLY-CEMENTED LAYERS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 96 | 0 |
| 20 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 48 |
| 25 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Thick Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 58 |
| 30 | | | Boring Terminated | | | | | | | | |
| 35 | | | | | | | | | | | |

REMARKS:

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 5
PAGE 1 OF 2

JOB NO. 040623 Crawford County
JOB NAME: Natural Dam - North Strs. & Apprs. U.S. 59
STATION: 218+00
LOCATION: 21' Right of Center Line of Construction
LOGGED BY: David Allen

DATE: October 21, 2014
TYPE OF DRILLING: Hollow Stem Auger & Diamond Coring
EQUIPMENT: CME 850 w/ CME Automatic Hammer
HAMMER CORRECTION FACTOR: 1.23

COMPLETION DEPTH: 43.6

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 642.1 | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | X | Moist, Dense, Brown Sand with Gravel (Sandstone Fragments) and some Clay | | | | | | 10<br>9-22 | | |
| 10 | | X | Wet, Very Dense, Brown Sand with Gravel (Sandstone Fragments) % * | | | | | | 60<br>(5") | | |
| 15 | | | Sandstone Gravel, Cobbles and Boulders | | | | | | | 32 | 12 |
| 20 | | | SANDSTONE WITH OCCASIONAL POORLY-CEMENTED LAYERS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip and Fractured Layers * | | | | | | | 30+ | 0 |
| 25 | | | | | | | | | | 76 | 24 |
| 30 | | | | | | | | | | 38# | 10 |
| 35 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip * | | | | | | | | |

REMARKS: % Water stratum at 9.6'. * Total water loss was encountered from 10.9' to 23.6'. + Poor core recovery due to gravel layer. # Pore core recovery due to inner core barrel not locking in.

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 5
PAGE 2 OF 2

JOB NO. 040623 Crawford County
JOB NAME: Natural Dam - North Strs. & Apprs. U.S. 59
STATION: 218+00
LOCATION: 21' Right of Center Line of Construction
LOGGED BY: David Allen

DATE: October 21, 2014
TYPE OF DRILLING: Hollow Stem Auger & Diamond Coring
EQUIPMENT: CME 850 w/ CME Automatic Hammer
HAMMER CORRECTION FACTOR: 1.23

COMPLETION DEPTH: 43.6

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE ELEVATION: 642.1 | | | | | | | | |
| | | | | | | | | | | 100 | 66 |
| 40 | | | | | | | | | | 100 | 54 |
| 45 | | | Boring Terminated | | | | | | | | |
| 50 | | | | | | | | | | | |
| 55 | | | | | | | | | | | |
| 60 | | | | | | | | | | | |
| 65 | | | | | | | | | | | |
| 70 | | | | | | | | | | | |

REMARKS: % Water stratum at 9.6'. * Total water loss was encountered from 10.9' to 23.6'. + Poor core recovery due to gravel layer. # Pore core recovery due to inner core barrel not locking in.

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 5A
PAGE 1 OF 1

JOB NO. 040623 Crawford County
JOB NAME: Natural Dam - North Strs. & Apprs. U.S. 59
STATION: 218+00
LOCATION: 42' Right of Center Line of Construction
LOGGED BY: David Allen

DATE: October 28-29, 2014
TYPE OF DRILLING: Hollow Stem Auger & Diamond Coring
EQUIPMENT: CME 850 w/ CME Automatic Hammer
HAMMER CORRECTION FACTOR: 1.23

COMPLETION DEPTH: 33.3

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 642.3 | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | X | Moist, Medium Dense, Brown Sand with Gravel (Sandstone Fragments) | | | | | | 7<br>8-8 | | |
| 10 | | | Wet, Very Dense, Brown Sand with Gravel (Sandstone Fragments) | | | | | | 60<br>(1") | | |
| | | | SANDSTONE WITH OCCASIONAL POORLY-CEMENTED LAYERS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip * | | | | | | | 69 | 50 |
| 15 | | | SANDSTONE WITH POORLY-CEMENTED LAYERS AND OCCASIONAL DARK GRAY SHALE SEAMS - Gray, Thick Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 34 |
| 20 | | | SANDSTONE WITH OCCASIONAL POORLY-CEMENTED LAYERS AND SHALE PARTINGS - Gray, Thin Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 0 |
| 25 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Thick Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 54 |
| 30 | | | SANDSTONE WITH DARK GRAY SHALE SEAMS - Light Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 86 |
| 35 | | | Boring Terminated | | | | | | | | |

REMARKS: * Total water loss was encountered at 11.0'.

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 6
PAGE 1 OF 1

JOB NO. 040623 Crawford County
JOB NAME: Natural Dam - North Strs. & Apprs.
U.S. 59
STATION: 218+86
LOCATION: 8' Left of Center Line of Construction
LOGGED BY: David Allen

DATE: October 20, 2014
TYPE OF DRILLING: Hollow Stem Auger & Diamond Coring
EQUIPMENT: CME 850 w/ CME Automatic Hammer
HAMMER CORRECTION FACTOR: 1.23

COMPLETION DEPTH: 33.1

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 643.4 | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Moist, Medium Dense, Brown Sand with some Clay | | | | | | | | |
| 5 | | | Moist, Medium Dense, Brown Sand with Gravel (Sandstone Fragments) | | | | | | 10<br>12-12 | | |
| 10 | | | Gravel (Sandstone Fragments) with some Sandy Clay | | | | | | 60<br>(4") | | |
| | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 84 | 60 |
| 15 | | | | | | | | | | 100 | 81 |
| 20 | | | | | | | | | | 100 | 78 |
| 25 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Thick Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 96 |
| 30 | | | | | | | | | | 98 | 92 |
| 35 | | | Boring Terminated | | | | | | | | |

REMARKS:

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 7
PAGE 1 OF 2

JOB NO. 040623 Crawford County
JOB NAME: Natural Dam - North Strs. & Apprs.
U.S. 59
STATION: 219+44
LOCATION: 3' Right of Center Line of Construction
LOGGED BY: David Allen

DATE: October 15-16, 2014
TYPE OF DRILLING: Hollow Stem Auger & Diamond Coring
EQUIPMENT: CME 850 w/ CME Automatic Hammer
HAMMER CORRECTION FACTOR: 1.23

COMPLETION DEPTH: 37.4

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION: 644.4 | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | X | Moist, Medium Dense, Brown Sand with Gravel (Sandstone Fragments) | | | | | | 9<br>11-12 | | |
| 10 | | X | Wet, Dense, Brown Sand with Gravel (Sandstone Fragments) | | | | | | 3<br>20-15 | | |
| 15 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Medium Bedded, Slightly Weathered, Well-Cemented, with Slight Dip | | | | | | 60<br>(1") | 100 | 38 |
| 20 | | | SANDSTONE WITH DARK GRAY SHALE PARTINGS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 98 | 60 |
| 25 | | | | | | | | | | 100 | 40 |
| 30 | | | SANDSTONE WITH DARK GRAY SHALE SEAMS - Gray, Medium Bedded, Slightly Weathered, Cemented, with Slight Dip | | | | | | | 100 | 78 |
| 35 | | | | | | | | | | | |

REMARKS:

**ARKANSAS HWY. & TRANS. DEPARTMENT**
**MATERIALS DIVISION - GEOTECHNICAL SEC.**

BORING NO. 7
PAGE 2 OF 2

JOB NO. 040623 Crawford County
JOB NAME: Natural Dam - North Strs. & Apprs.
U.S. 59
STATION: 219+44
LOCATION: 3' Right of Center Line of Construction
LOGGED BY: David Allen

DATE: October 15-16, 2014
TYPE OF DRILLING: Hollow Stem Auger & Diamond Coring
EQUIPMENT: CME 850 w/ CME Automatic Hammer
HAMMER CORRECTION FACTOR: 1.23

COMPLETION DEPTH: 37.4

| DEPTH FT. | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | SOIL GROUP | PLASTIC LIMIT | % MOIST. | LIQUID LIMIT | DRY WEIGHT LBS PER CU.FT. | NO. OF BLOWS PER 6-IN. | % SCR | % RQD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE ELEVATION: 644.4 | | | | | | | 100 | 84 |
| | | | Boring Terminated | | | | | | | | |
| 40 | | | | | | | | | | | |
| 45 | | | | | | | | | | | |
| 50 | | | | | | | | | | | |
| 55 | | | | | | | | | | | |
| 60 | | | | | | | | | | | |
| 65 | | | | | | | | | | | |
| 70 | | | | | | | | | | | |

REMARKS:

## ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

September 16, 2015

**TO:** Mr. Rick Ellis, Bridge Engineer

**SUBJECT:** Job No. 040623
Natural Dam – North Strs. & Apprs. (S)
Route 59 Section 5
Crawford County

The foundation recommendations included in this memo shall be supplementary to those included in the IOM dated November 20, 2014. At that time it was anticipated that all bents would be founded on piling. After discussions with Bridge Design, it is anticipated that all intermediate bents will be founded on drilled shafts. Drilled shafts socketed a minimum of two times the shaft diameter into the competent, gray, cemented sandstone with dark gray shale partings and seams should be sized based on the values provided in Table 1.

TABLE 1 – Bearing Capacity Recommendations for Drilled Shafts

| Foundation Description | Nominal Shaft Side Resistance (ksf) | Factored Shaft Side Resistance (ksf) | Nominal Shaft Tip Resistance (ksf) | Factored Shaft Tip Resistance (ksf) |
|---|---|---|---|---|
| Drilled Shafts | 11.7 | 6.4 | 183 | 92 |

It is anticipated that Bent 1, station 213+65, will be founded on a spread footing and should be sized based on the values provided in Table 2. It is anticipated that Bent 7, station 219+67, will be founded on piling. Preboring may be necessary to achieve minimum penetration requirements.

TABLE 2 – Bearing Capacity Recommendations for Spread Footings

| Foundation Description | Nominal Bearing Resistance (ksf) | Resistance Factor | Factored Bearing Resistance (ksf) |
|---|---|---|---|
| Spread Footings | 24.8 | 0.45 | 11 |

If you have any questions concerning these recommendations, please contact the Geotechnical Section.

Michael C. Benson
Materials Engineer

MCB:rpt:mlg

cc: State Construction Engineer - Master File Copy
District 4 Engineer
G.C. File