SUBJECT: Hardin County
FD04 047 3005  
KY 3005 (Ring Road)  
60’x 10’ 3-sided culvert @ Station 124+55.18  
MARS # 65893 01D  
Item Number 4-7010.50  
Geotechnical Engineering Structure Foundation Report

1.0 INTRODUCTION

The proposed project consists of the design and construction of the extension of Ring Road (KY 3005) from Gaither Station Road to the Western Kentucky Parkway in Elizabethtown.

This report addresses the geotechnical issues for the proposed design and construction of the 60 x 10 foot, 3-sided culvert at Station 124+55.18.

A geotechnical engineering structure foundation report was originally issued on this project on March 26, 2004 as report number S-035-2004. The culvert was not drill rig accessible at that time due to the culvert being located in a corn crop field. Only manual rod soundings were obtained. No soil samples were obtained and soil testing was not performed. Therefore, the allowable bearing capacity was estimated to be 2 ksf.

Subsurface information could not be obtained at some other locations on the project due a property owner denying access. The project was put on hold until access was obtained in November 2010.

Originally, the structure was designed as a 20 x 7 foot RCBC. The drilling was performed for this culvert in December 2010 showing that bedrock was not within 3 feet of the flowline of the culvert, whereas, this culvert would be designed for a yielding foundation. An addendum to the report S-035-2004 was issued on January 20, 2011 (Report # SA-016-2010). Advancing the borings to bedrock was not necessary for this type of culvert.

The structure has now been changed to a 3-sided culvert. Additional drilling was required due to the bedrock elevation being critical for this type of structure.
The abbreviated geotechnical engineering report addendum for this structure has been completed. The .DGN file for the subsurface datasheet is available on Projectwise and through e-mail for use in developing the structure plans. The structure is in the Cecelia (#263) Geologic Quadrangle. The geologic mapping indicates that the bedrock at this site is of the Ste. Genevieve and the St. Louis Limestone Formations.

2.0 SUBSURFACE CONDITIONS

Sixteen additional holes were drilled for the 3-sided culvert. Four holes were soil sample and rock core borings, and the remaining twelve holes were mechanical rockline soundings. Thin-walled tube samples and standard penetration test samples were utilized for sampling. This is a highly karstic area. The bedrock elevation varied from 676.7 feet to 658.3 feet. Soils sampled at this location consisted primarily of clays with silty sands encountered in the streambed. The Unified Classification of the soils was CL, CH, SM, and SM-SC.

3.0 ENGINEERING ANALYSIS

Due to the low embankment heights, a settlement analysis was not necessary. Embankment stability is of little geotechnical concern utilizing 2H:1V slopes or flatter.

The soil strength parameters were determined from conservatively correlating SPT N-values and soil classifications with published values found in NAVFAC DM-7.2 and the FHWA Soils and Foundations Workshop Manual.

The 100 year flood elevation is 683.54 feet. The soils, at this location, have potential to scour. Potential scour depth calculations have not been performed. However, Cyclopean Stone Riprap is recommended as a scour abatement measure. The riprap shall be placed from the top of the stream bank to the walls of the culvert and extending to 10 feet beyond the culvert inlet and outlet. This riprap should protect the footings from damaging scour.

4.0 FOUNDATION RECOMMENDATIONS

The recommendations given below are for a precast structure.

4.1 Foundation Alternate

4.1.1 Alternate 1 – Spread Footings on Soil: The spread footings shall be founded on soil. Size the footing at service limit state using a factored nominal bearing resistance of 2.2 ksf. For checking strength and extreme limit states, the nominal bearing resistance has been determined to be: 6.6 ksf. Use a resistance factor of 0.45 for strength limit state analysis and a resistance factor of 1.0 for extreme limit state analysis.
4.1.2 Alternate 2 – Granular Replacement: The spread footing shall be founded on granular replacement material using the allowable bearing pressures shown on the attached sheet. The required depths of the granular replacement shall be shown on the plan sheet.

4.1.3 Alternate 3 – Pile Foundation: Use piles founded on bedrock. The estimated pile tip elevation will vary from 676.7 feet to 658.3 feet.

4.2 The wingwalls should be designed using Soil Type 3 of Exhibit 413 in the Division of Bridge Design Guidance Manual. It should be noted that the backfill slope being referred to is that perpendicular to the wingwall.

4.3 Backfill the pre-cast structure and the accompanying wingwalls according to the manufacturers’ specifications.

4.4 Cyclopean Stone Rip-Rap shall be placed as a scour abatement measure inside the culvert. The riprap shall be placed from the top of the stream bank to the culvert walls and extend a minimum of 10 feet beyond the culvert inlet and outlet. The limits, size and thickness of cyclopean stone shall be designed for applicable flood flow velocities at the approach slopes of the bridge. Place a Type I, Geotextile Fabric as a separator between the soil and the stone. The Geotextile Fabric shall be in accordance with Sections 214 and 843 of the Standard Specifications for Road and Bridge Construction, current edition.

4.5 Granular replacement material, if utilized, shall consist of “Granular Embankment.” The Granular Embankment shall be non-erodible only, meeting the material requirements of section 805 in the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. Contrary to the Standard Specifications, the maximum size limit for Granular Embankment is 4 inches. The excavation for the granular replacement shall extend a minimum width beyond the edges of the footings equal to the replacement depth. The granular replacement shall be placed on a 1H:1V slope or flatter from the base of the footing to the bottom of the excavation. Place a Type I, Geotextile Fabric as a separator between the soil and the granular replacement. The Geotextile Fabric shall be in accordance with Sections 214 and 843 of the Standard Specifications for Road and Bridge Construction, current edition.

4.6 The base of footing shall be placed at a minimum of 2 feet below the streambed.
5.0 PLAN NOTES

5.1 Temporary sheeting or shoring and a dewatering method may be required for installation of the footings.

5.2 Cyclopean Stone Rip-Rap shall be placed as a scour abatement measure inside the culvert. The riprap shall be placed from the top of the stream bank to the culvert walls and extend a minimum of 10 feet beyond the culvert inlet and outlet. The limits, size and thickness of cyclopean stone shall be designed for applicable flood flow velocities at the approach slopes of the bridge. Place a Type I, Geotextile Fabric as a separator between the soil and the stone. The Geotextile Fabric shall be in accordance with Sections 214 and 843 of the Standard Specifications for Road and Bridge Construction, current edition.

Include the following note if spread footings on granular replacement is used.

5.3 Granular replacement material shall consist of “Granular Embankment.” The Granular Embankment shall be non-erodible only, meeting the material requirements of section 805 in the current Kentucky Department of Highways Standard Specifications for Road and Bridge Construction. Contrary to the Standard Specifications, the maximum size limit for Granular Embankment is 4 inches. The excavation for the granular replacement shall extend a minimum width beyond the edges of the footings equal to the replacement depth. The granular replacement shall be placed on a 1H:1V slope or flatter from the base of the footing to the bottom of the excavation. Place a Type I, Geotextile Fabric as a separator between the soil and the granular replacement. The Geotextile Fabric shall be in accordance with Sections 214 and 843 of the Standard Specifications for Road and Bridge Construction, current edition.

Please feel free to contact this office if there are any questions pertaining to this report.

Attachments
Allowable Bearing Pressure at Bottom of Footing for Various Footing Sizes and Depths of Granular Replacement

Depth of Granular Replacement beneath footing (ft)

Allowable Bearing Pressure at base of footing (psf)

- 2' footing width
- 3' footing width
- 5' footing width
- 10' footing width
- 15' footing width
**COORDINATE DATA SUBMISSION FORM**

KYTC DIVISION OF STRUCTURAL DESIGN – GEOTECHNICAL BRANCH

**County**
- Hardin County

**Road Number**
- KY 3005 (Ring Road)

**Survey Crew / Consultant**
- District 4 Crew 204

**Contact Person**
- Mark Cannon

**Item #**
- 4-7010.00

**Mars #**
- 65893 01D

**Project #**
- FD04 047 3005

Elevation Datum = NAVD88

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**Notes:**
- Project Datum coordinates were used, based on KY South 1602